KNOWING AND KNOWING HOW

A Self-help manual on technology for women in the Pacific

EDITED AND
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FORWORD

This manual is a first attempt at compiling information for women in the Pacific of simple technologies which can assist their work. It is part of a series of manuals aimed at giving women in the Pacific access to information which will enable them to help themselves to development. Although most of the techniques presented in this manual are related to women's work around the home, it is not intended to imply that it is accepted that this is what women's role should be or that this work should be solely done by women. However, given the present circumstances and roles of women, relieving the drudgery of women's work in the home is seen as the most pressing area of need.

A second manual giving comprehensive information on women's health will follow this publication. Two further manuals are planned, one on nutrition and food production and one on income-earning activities. It is hoped that these manuals, as part of a Pacific Women's Resource Kit, will break through the barrier women face in helping themselves to the benefits of new developments, and give them inspiration to be active agents of change. It is recognized however, that changes in the position of women can only truly be achieved when social attitudes, ideas, prejudices and practices against women are changed and women are accepted as equals and given opportunities to play unlimited roles.

The manual was compiled over a two month period, using existing materials available on appropriate/intermediate technology. Only in a few instances were the use of these materials observed in the field. We had no detailed information on how they are in use. Where instructions were not available, information is presented to add to women's knowledge of different techniques and further references of where to find more information, are given. Users of this book may also approach appropriate skilled persons (for instance, in technical colleges, government departments) in their own countries for more information or assistance.

The main idea was to make as best a selection as possible of the existing information on areas affecting women's work where this information may lighten that work. The book is primarily intended for women in the rural areas, village women, and field workers or women's clubs who may be able to initiate activities around some of the information provided here. The main attempt of the book was simply to put this information in one place, so that women working with or concerned with women in the rural areas, may have simple technology improvements that may help ease the burden of women's lives. We make no recommendation that only women should use this book (indeed we hope not) or that the how-to-do-it part of the book need be done by women alone. Help from other women and from the community would benefit all.

This manual is a first edition. Response from readers and users of this manual may lead to a second edition containing more information, or a change in contents to cover areas that women also want included.

INTRODUCTION

Technology

Technology can be defined as the set of tools, knowledge, techniques and systems of doing things with which people react with their environment and supply their needs. All societies have technology, whether it be the simplest of hand tools or sophisticated machines. The knowledge behind the use of these tools is also part of technology. In the Pacific for example, a whole body of knowledge of the stars, sea currents and winds is behind the building and use of sailing canoes. Women also, in the work that they do, contribute to the technology of a society. Their ways of planting food, cooking and preserving it, are very important to a society's successful reaction with the environment to provide food, a basic need. Societies have reacted in different ways to their environment and have developed different types of technology. No single type of technology is better than another type; different technologies simply reflect the different conditions and environment of the societies in which the technology was developed.

Today, with communication and trade between countries, there is a range of technologies which countries can adopt and import for their own use. Most of the transfer of technology has tended to be from the industrialised countries to the so-called 'developing' countries. Developing countries have been interested in importing this technology because their economies follow along lines set towards supplying the needs of the industrialised nations. The technology that is imported has tended to relate to large scale developments in agriculture, cash crops and industrial projects and is less related to areas where people most need improvements, for instance in housing food production, water supply and health. Even when imported technology is related to these areas, it is often at a cost which most people cannot afford.

Technology Dependency

There is some debate now over the import of technology and how decisions related to technology are made. The technology imported comes mainly from the industrialised countries, and it is imported at great cost. A large part of the income of developing countries goes towards the import of technology. Most of these countries do not have the knowledge or trained persons to use this new technology, so part of the importation also involves experts to operate and maintain and be in control of the technology when it is used. The knowledge which the experts have must also be passed on, at more cost to the developing country. Sometimes training of local persons to take over control is not done or is done at a very slow pace. Developing countries therefore become totally dependent on the industrialised countries for their technology.

Other criticisms levelled at the import of technology from other countries are that the technology is not always 'appropriate' or suited to the conditions in the countries they will be used in. The level of technology imported, for instance if it is for large

scale agricultural developments or industries, means that it will reach only a certain group of people who are in positions to use this technology. Any benefits from the new technology will not necessarily reach a majority of people. Technology can therefore serve the interests of some people as against the interests of people who may need technology most to realise their needs, for instance, poor people in the rural areas.

A lot of attention is now being paid to 'appropriate' technology or intermediate technology, which are popular terms used to refer to technology which is more suited to serving peoples needs and which is suited to the conditions of the countries in which the technology is used. Technology which is simple to use and easy to repair, which does not cost too much and which enables people to make better use of their own resources are points advocated by those recommending use of appropriate technology. However, it is not technology alone that needs to be appropriate, but the type of development and priorities that developing countries follow.

Development and Its Impact

European contact and colonisation of developing countries brought about a great change in the traditional economies of the countries concerned. This change in the economic production of the countries brought about a change in the societies and in the roles of men and women.

Most developing countries, once under colonial control were forced to develop in ways which suited the colonial power. Technology was put to use to extract resources which would be of use to the colonial powers. From that time, new technology was brought to use but to take from the environment to serve the needs of the industrialising countries. In addition, different techniques were put to use to establish a new system of agriculture - that of producing cash crops on a plantation scale for export. Crops such as coffee, tea, sugar, cocoa, cotton, were planted to provide the mills and factories in Europe which were industrialising and had developed the technology to process these crops. Countries which had once been colonies, even after gaining their political independence, have continued to follow this type of economic production. Their choice of technology is also related to supporting this system. What is produced from the environment is not eaten, consumed or used in the countries they are produced in but is sent overseas. In return the countries receive cash. This is called international trade. However, at any time, the industrialised countries buying these products can change the prices they will pay for them, which is what is referred to when talking about a rise or fall in international prices.

Countries receiving payments for these resources which are raw materials which have not been processed, may spend most of their earnings importing these same products, now processed through technology by the industrialised country. If developing countries try to process the materials themselves, they have to import the technology and the processing expertise from the industrialised country.

This is very costly and even if countries successfully process their own resources, this is sometimes at a greater cost than it would be if they bought them. So developing countries are in a bind. They continue to produce crops and let resources be extracted from their countries for the benefit of countries overseas. Their labour, energy and resources continue to go towards producing for export. Technology imported is for the purpose of increasing this type of production. The benefits gained are sometimes not evenly distributed within the developing countries, so that not all the people benefit from this type of economic production.

This process is called development, yet for the majority of the people it may not mean development if in their daily lives no benefits reach them as a result of this 'development'. The countries are called developing because they have not reached the level of technology that the industrialised countries have. Developing countries often presume that a certain type of technology will lead to better development. In this context, the choice of technology is very important, but so too is the type of development that any new technology will serve.

Women and Development

The type of development outlined above has affected women in many ways. For the most part it has resulted in an increase in women's work load, as they are forced to carry more of the burden of food production, while men spend their time on cash crops or are given over to labour for wages. Where men and women traditionally would have shared the work involved in clearing the land, planting, weeding and harvesting, the production of food is now come to be regarded as women's work. Women receive less help in this work because agricultural production of food for family consumption is given less priority than the production of cash crops for export. The cash from this crop or the money paid for labour spent on it, is meant to provide families with their income, but in most cases the men regard this income as theirs, so women and the family do not benefit. Women's production on the other hand, goes back into the family, and even cash earned from surplus produced by women is spent on the family needs.

Development has meant that the best land is given over to cash crops, leaving the less fertile and more difficult to reach land for women to use for food production. Women have also had their workload increased by the help they give in the production of cash crops. Development has meant that now women are not only responsible for raising the children, for care of the household, and for food production but they also help with cash crops. The effect of this type of development has been to increase women's workload to cover more areas of responsibility. Yet women's contribution to development, especially in the rural areas, is not acknowledged. This is because development is seen in terms of production that can be translated into cash, while the work that women do is in areas where there is no payment for the labour spent - that is, work in the home, raising of children, and production of food for family consumption.

Since women are not considered as economic producers, they are not considered in development or as persons in need of new technology which would lighten their work or increase their production. Women could, with technology, which includes knowledge of new techniques, finance, information and training, also be able to increase their production to earn more income. But before women can take advantage of this, they need to be able to reduce the amount of time and energy they spend on the unrewarding, and burdensome tasks centred around the home. Women in rural areas must fetch water every day, sometimes from long distances, they collect firewood and spend hours of cooking over simple open fires which are often injurious to their health. In addition they care for children, feed the family, and provide for most housing utensils that they need. Outside the home, women work on the land, producing food. Traditionally, women also contribute to men's tasks such as house building and boat building by contributing to certain parts of their construction with their skills of weaving, plaiting etc.

Women need technology improvements which will help them with their work. Women also need the information, opportunities as well as technology input to be able to increase their production and their income earning ability. Without technology to help with women's work and their chances of earning an income, women will remain economically dependent and continue to be given low recognition. Recognition of the amount of work that women do and their contribution to development, especially in the rural area, is needed if the status and position of women are to improve.

ENERGY

What is Energy?

Energy is the power which can move man and machines to function. Petrol for instance is a fuel which when burned is the energy source behind a car or truck which makes it run. Electricity when generated from an energy source lights our houses and our stoves and enables us to cook. Kerosene when burned is another source of energy which may give us light or we may use kerosene for cooking instead of electricity. These are common ways in which we use energy every day. Human labour is a major source of energy which we use.

Some sources of energy are more expensive than others. Oil and petroleum are commonly used fuels, used as an energy source but not all countries have their own supply. We import petrol and kerosene from other countries because we do not have these resources ourselves. Even electricity, which may be generated in our own countries, is produced by generators which run on fuel which we import. Our source of energy is then very dependent on imports from other countries which sell these fuels to us. When prices for fuel go up, we are forced to pay them because we have no choice. Most countries are dependent on oil producing countries for their energy needs.

Other Sources of Energy

But there are many other sources of energy available to us which we can use to cut down on our energy imports and be more independent. The sun, wind, and water can also provide energy which can be used to do many of the things which now run on fuel or electricity.

Solar Energy

Solar energy, which is energy that comes from the infra-red light of the sun, can be collected and used for heating water, cooking and heating buildings. Solar energy can also be stored and converted to electricity through use of solar cells. These are expensive and have to be imported but this may be still be cheaper than fuel-generated electricity, especially for household use.

Solar energy is not new. When food is dried in the sun, this is using solar energy and people all over the world have used solar energy to dry vegetable and animal products to get salt from salt water and to preserve food, to give a few examples. Technology used can be developed to enable us to use the sun's energy in more ways than we do now. Experiments have been done to produce solar cookers, solar generated electricity and solar heating systems for houses. Some simple methods of using the sun to dry food and to make salt are described later in this book.

Wind Energy

The wind is another source of energy. Again it has been used for thousands of years. Wind is used to propel sailing ships and to drive windmills which can grind corn or pump water. The Pacific would not have been populated if there had not been wind to drive canoes across the ocean! Wind mills can be used to pump water for

irrigation, wind can be used to move machines and generate electricity.

Hydro or Water Power

The fall of flowing water can be used to generate electricity. The force behind flowing water has been used for centuries as an energy source. Water falling on paddles or buckets attached to a wheel was used to raise water for irrigation or water supply. The hydraulic ram pump uses flowing water to pump water to a place above its source. That is, flowing water can be used to push water uphill to wherever it is needed. Large amounts of falling water can be used to generate electricity for a whole city or a country's needs. Some countries in the Pacific such as Fiji and Papua New Guinea are going into hydroelectricity power schemes.

Methane Gas

This results after the breakdown of animal and vegetable waste matter in a closed container or tank. The break of the waste materials produces very good fertiliser and also methane gas, which can be used as a fuel.

A Word on Nuclear Energy

Nuclear energy is released through the splitting of the nucleus of certain substances such as uranium or plutonium. The heat released is converted into some sort of useful power for example, electricity. However, in making nuclear power, certain radioactive materials are left over from the process as nuclear wastes. Radioactive materials endanger life of plants and animals, including man. In man, radiation from radioactive materials can cause cancer; it can also cause genetic damage, which is damage to children born of parents who have been exposed to radiation.

Nuclear wastes remain radioactive for a very long time and have to be disposed of carefully. Some countries using nuclear power have looked to other countries or to the oceans, to dispose of these wastes. This can cause damage to the environment and the people there. An area of the Pacific in Micronesia is being proposed for dumping of nuclear wastes. Many Pacific countries oppose this, because it means the Pacific is forced to bear the bad effects of a technology choice made by other countries.

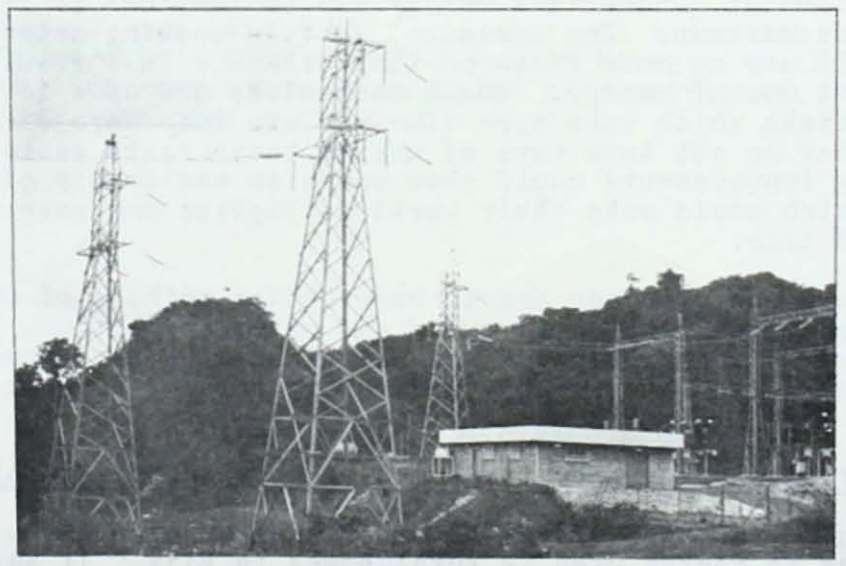
Using different Sources of Energy available to Us.

The sun, wind and water are some sources of energy which can be used which are available to us in our own countries. We need to put some thought into how we can make more use of these sources of energy, on a large scale, for example for our country, or on a small scale, for our community or family.

Energy choices

Fiji and Papua New Guinea are going into large scale hydroelectricity schemes to provide electricity for their country using the power of water. On schemes of this size, which will save the

Power Station being built as part of Monasavu Hydro electric scheme, Fiji.



Power lines which will be transferring the electricity to where it will be used.

country a lot of money which it would otherwise spend on fuel, there are some questions we also need to look at.

For hydro schemes usually a large dam has to built to hold back water. When this water is released, the power behind the fall of water is used to generate electricity. How will this large scheme affect the environment and the people living there? What will happen to people living in the area of the dam? What will happen to the wildlife that will be covered by water when the dam is created? Who will benefit from the creation of electricity? Will it just go to the people in the towns and be used for big industries owned by foreign companies? Or will the electricity be spread to the rural areas so that the people there can benefit?

A decision must be made after we have asked all these questions. If the damage to the environment will be great and not everyone will benefit, could the government think of building small hydro-electric schemes for each village or district, so that people benefit? Maybe the schemes could be small enough for the people to manage themselves.

These are some of the choices involving energy and also technology. Are we using our own resources, are we using a technology which may do more harm than good, and could we pick a simpler system which people could use and operate for themselves.

Energy and Women

Women also need to know about energy and the different sources of energy available.

Most of the energy use in any household, rural or urban, is used by women. Women use energy to light fires or stoves for cooking or to heat water. Sometimes energy can be 'wasted' if it is not used to its maximum. For instance, certain cooking methods or stoves will use up more firewood than others. This results in an inefficient use of energy. Women themselves use up a lot of energy in doing tasks which take more time and are made more difficult because they do not know ways of making these tasks easier. Simple technology improvements could show women an easier way of doing things, which would make their workload lighter and save women's energy and time.

Women's main energy needs are to have better methods of cooking, and to spend less.time on firewood and water collection. In dealing with women's energy needs, we will look at better woodburning stoves, improving water supply, and using solar energy to preserve food.

Most Important Energy Need for Women - Improved Wood Burning Stoves

Many women do not have stoves but cook over an open fire. In a survey done on energy used in rural homes in Fiji,[1] it was found

[1] *Siwatibau, Suliana, A Survey of Domestic Rural Energy Use and Potential in Fiji, Centre for Applied Studies in Development, University of the South Pacific, October, 1978.*

that most women cooked over an open fire. This way of cooking is only 5-10% efficient, which means that only 5-10% of the heat created is actually used for cooking while the rest is wasted. So with a whole bundle of firewood that a woman might collect, she would only use for cooking 5-10% of the heat it is possible for the wood to produce.

Another reason why women need better stoves for cooking is that cooking over an open fire is bad for their health. Many women in the Fiji survey complained of sore eyes related to cooking over open fires. Chest complaints have been connected with breathing in too much smoke and sleeping in smoky rooms. In some places smoke is used to dry food and keep away insects, but perhaps a better way can be found for doing this.

Most of the women spoken to in this survey wanted an improved method of cooking. Whenever people could afford it they switched to using kerosene as a fuel but this costs money. Women also were using a kerosene cooker called the Hong Kong round wick burner which in tests done by the New Zealand Consumer Council were shown to be dangerous in design and use. Families using these burners, particularly women, are at risk, and accidents have already occurred.

It is clear that women, not just in Fiji, need:

1) stoves that burn wood more efficiently
2) stoves which channel smoke away

The section which follows presents different cooking stoves which would use firewood more efficiently and also get rid of the amount of smoke produced during cooking. One or two stoves, which show use of an open fire, are given as examples of simple improvements which some women have made even in this area.

A. CHARCOAL

Making charcoal from wood

Charcoal burns better and more efficiently than wood. It burns with very little smoke and will not irritate the eyes. Charcoal can be made from scraps of timber, firewood, coconut wood from old tree trunks, coconut shells.

Following are instructions on:

i) How to make a charcoal kiln from a 200 litre drum
ii) How to make charcoal for cooking purposes
iii) Charcoal cookers

Making your own charcoal has the following advantages:

1. You can make it at the place of firewood collection and avoid having to carry heavy amounts of wood.
2. Charcoal lasts longer than the same amount of wood and burns better.
3. Charcoal will not produce too much smoke.
4. Cooking is easier and quicker with charcoal.

1. A Tongan Kiln

(NOTE: This kiln was designed by Miss Temaleti Vakasiuola of Tonga, who produced charcoal from coconut wood and exported it to New Zealand as part of her own business).

Material required:

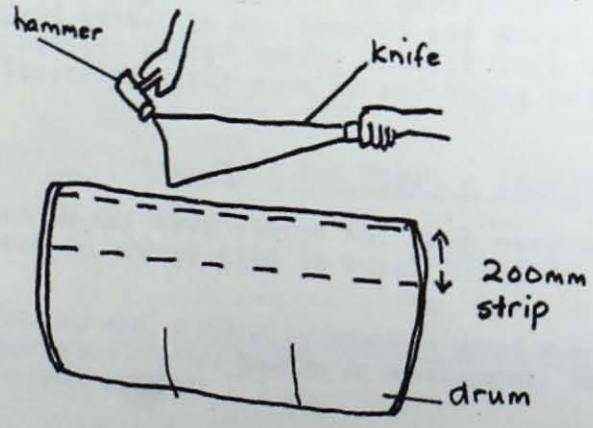
1 empty 200 litre steel drum in good condition (no holes, big dents, or rusting)

Tools:

a cold chisel, a hammer, a caneknife (bushknife)

How to Make the Kiln

1. Make sure there is no oil or petrol in the drum. Wash inside with soap and water, or detergent and water.
2. Cut a strip about 200 mm wide along the full length of the drum. TO CUT - start with the cold chisel and then use the caneknife and hammer to complete the cut.
3. Pull out the cut piece of drum to form an opening. Keep the cut piece. In the last stage of charcoal making it will be used to seal the drum.



Cutting out 200 mm strip along oil drum

2. Making Charcoal

A. Getting the wood ready:

1. Cut logs about 30-50 mm in length (or 1¼-2 ins.)
2. You will get more charcoal and better quality if the wood is very dry. For making the best charcoal, wood should be cut and stacked for drying for at least 4-6 weeks.
3. Thick pieces of wood could be split into smaller sizes to help dry the wood better.

B. Using the Kiln:

1. Get materials ready to start a fire - dry grass, twigs, leaves or small pieces of wood. Place wood to be charcoaled next to kiln. If possible use asbestos gloves or thick wet cloth tied around the hands to protect them from burning.
2. Lie the kiln on its side with the opening facing the wind. Let the bottom edge of the opening be about 75 mm (or 3 ins.) off the ground. Prop the kiln in place with a stone.

Kiln propped 75 mm above the ground

3. Spread the dried twigs, leaves and grass inside the kiln to cover its whole length and start the fire.
4. As the fire begins to light and spread, add the split and small pieces of wood.
5. The kiln must always face the wind because it is important to have a strong and even fire for making the charcoal. If the wind changes, TURN THE KILN to face the wind again. USE asbestos gloves or heavy cloth wrapped around the hands to protect from burning.

C. First Loading

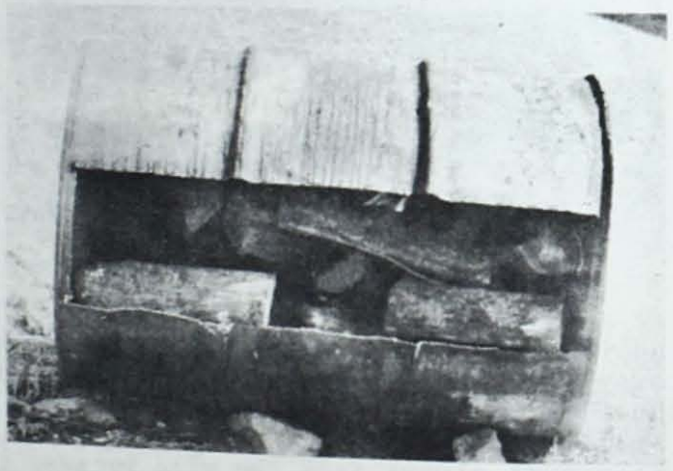
1. When there is a good, strong and even fire going, add the pieces of wood slowly. Add the small pieces first so that the fire remains the same.
2. Stop adding wood when the level comes up to just above the lower edge of the opening.

First loading

3. Let the pieces of wood burn into embers then roll the kiln, removing the stone that has been propping it up at 75 mm above the ground.

D. Second Loading

1. Prop the kiln so that the bottom edge of the opening is now 150-200 mm off the ground. This is to stop air from reaching the charcoal that has already been formed during the first loading.
2. Add more wood slowly, keeping the strength of the fire the same. Stop adding wood when the level comes up to the bottom edge of the opening.



Second loading

3. Leave the wood for a time to burn until it looks like embers i.e. the wood is burnt down. Roll the kiln back.

E. Third Loading

1. Prop the kiln so the edge of the opening is about 300-400 mm from the ground.
2. Add the large pieces of wood. Make sure the fire is kept at the same strength.

Third Loading

3. Stop adding wood when the level comes to the TOP EDGE of the opening.
4. Leave the wood for some time to burn.

F. Final Loading

1. Roll the kiln back so that the opening faces straight up.

Final Loading

2. Add large pieces of wood, making sure fire maintains its even burning and strength.
3. Fill the kiln with wood. Allow time for wood to burn to embers.

G. Sealing the kiln

1. When all the pieces of wood are burnt to embers, take the CUT-OUT PIECE OF TIN which was cut to make the kiln. Cover the opening of the kiln. Tie the cover firmly in place over the opening with two long pieces of wire. This stops the charcoal spilling out when the kiln is rolled over for sealing.
2. Roll the kiln over so that the sealed opening lies flat on the ground.
3. Pile sand or mud around the bottom edge of the kiln so that NO AIR CAN GET IN. Seal any holes or cracks in the kiln with mud or clay. THIS IS VERY IMPORTANT. If air enters the fire inside will continue to burn and ashes will be produced instead of charcoal.

SEALING THE KILN

Women at SPC Training Centre sealing a kiln with wire.

Piling sand around the bottom end of the kiln

4. Leave the kiln to get cool, about 6-10 hours. Take out the charcoal
5. Sift the charcoal to remove small pieces and ashes. The best size pieces for charcoal are about 13 mm x 13 mm or about ½ ins. x ½ ins. Keep the charcoal in a DRY place. Put it in drums, tins with a lid, or bags as soon as possible. Do not leave charcoal to become moist and damp.

Adapted from: Fabrication and Use of a Tongan Charcoal Kiln by S. Bulai, J.M. Richolson, Dept. of Forestry, Fiji Govt.

3. Charcoal Stoves

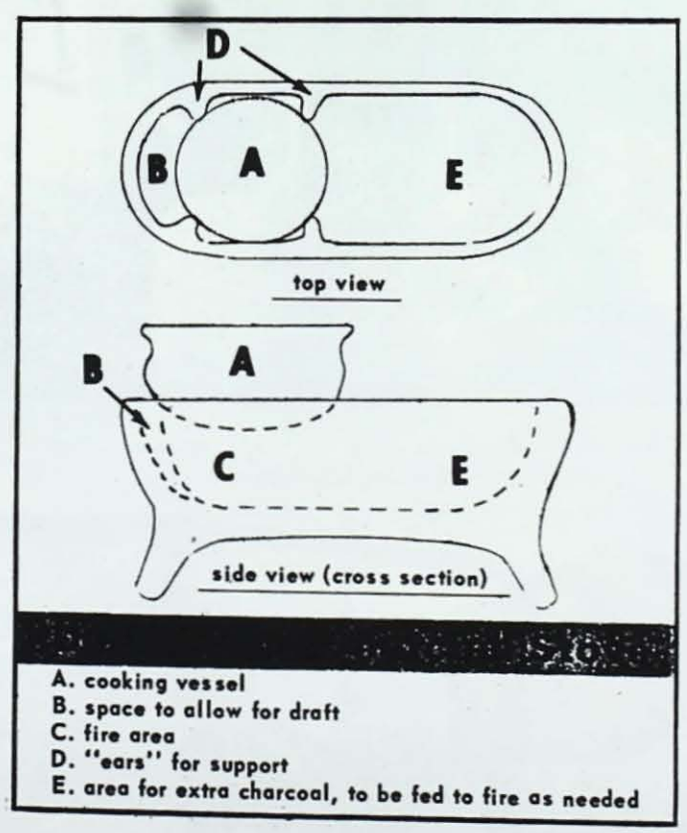
Charcoal produces a hot fire with a minimum of smoke. Charcoal can be used in any kind of stove or cooker where you would normally use wood. You will need less charcoal to cook with than you need wood. Charcoal making does take time, so you will have to decide whether you want to make your own charcoal or not. Charcoal is a help because:-

1. It can be easily stored and used later.
2. It has a stronger heat and less smoke,
3. It can be easily carried. The time spent fetching firewood is less.

Simple Charcoal burners

This is a simple charcoal stove which is used in the Phillipines. It is round but can be made another shape if you wish. It is made of clay and dented to form the fingers or prongs which hold the pot. It can also be made out of metal or cement.

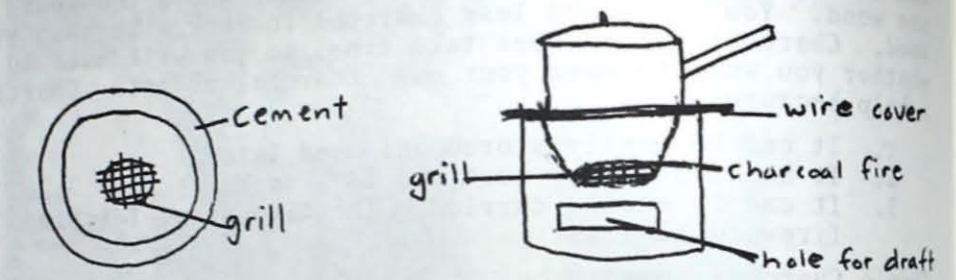
The pot (A) sits on top of the prongs. There is a space between the pot and the edge of the stove. This allows a draft or passage of air to go under the pot and keep the fire going at a steady pace. The charcoal is placed under the pot at (C), where the fire burns.



The charcoal stove is small and can be easily moved around. The stove can be used inside the house also because charcoal burns with very little smoke.

From: World Neighbours newsletter

2. Charcoal cooker (2). The South Pacific Commission Community Education and Training Centre (CETC) in Suva, teaches women how to make a simple charcoal stove something like this:



Top View *Side View*

It is made using two moulds for the top and bottom.

Simple charcoal cooker being made by community development students at the SPC Training Centre, Suva:

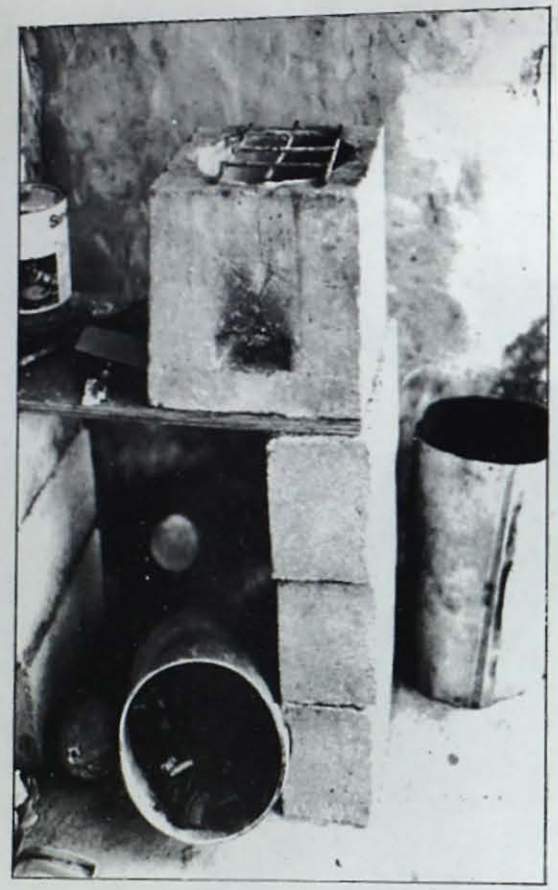
Kerosene tin drum sawn in half makes mould for charcoal cooker.

Mould filled with cement with front opening for draft to enter.

3. Charcoal burner made at Kristian Institute of Technology at Weasisi, Tanna, Vanuatu.

A charcoal burner

Moulds used to make burner (at middle and right).



Charcoal burner placed at height for cooking. Charcoal at bottom in bucket.

Chimney or chute placed on burner when lighting fire creates draft.

Charcoal pieces burning well soon after fire is lit.

B. OTHER SMALL STOVES

A Word on Fuel

Common sources of fuel are:

wood
charcoal
coal
other materials such as manure, sawdust, grain hulls (e.g. rice), coconut husks, dried grass

Other sources of fuel less commonly available to most people are:

kerosene
gas (bottled, and natural gas which comes from the breakdown of waste materials)
fuel oil
electricity

WOOD, COAL AND CHARCOAL are probably the most often used. They are not so costly and are easy to find. Coal is not used in the Pacific for household use. But forests and reserves of firewood are becoming scarce, as more and more people use up trees for timber, or clear the land for agriculture. The places where people can get wood for fuel are becoming smaller in area, and further away from where people live. We need to treat this as a problem because:

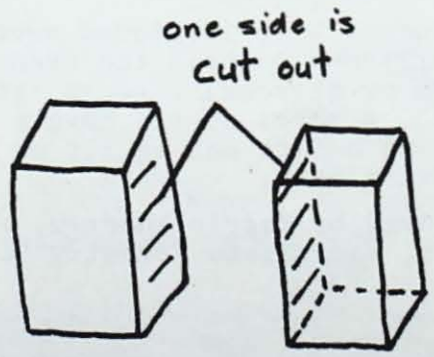
1. forests may be used up completely before new trees have grown back
2. as firewood becomes further away it increases the load and time women must spend carrying it
3. many people are forced to turn to more expensive fuels such as kerosene

One way to avoid this is to plant fast-growing trees to replace trees cut down for firewood. Another way is to save fuel by using better stoves and ovens.

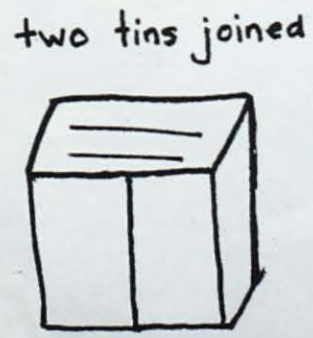
1. An oil tin oven

This oven is made of two 5-gallon oil tins joined together. One side of each tin is cut out completely. The two tins are joined together and this forms the oven space.

(i)



(ii)



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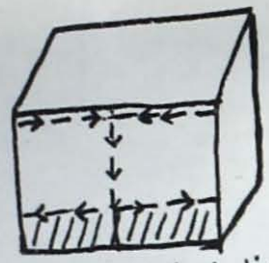
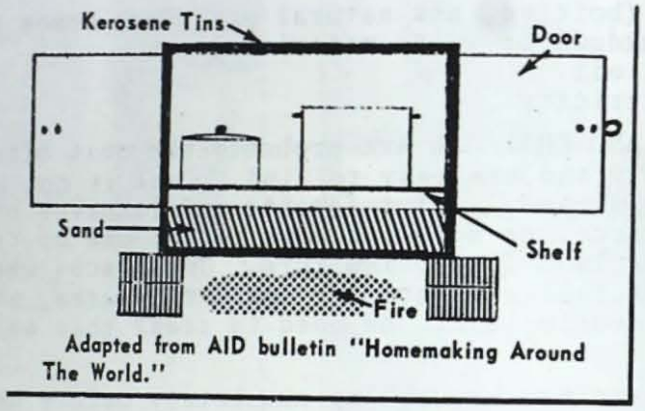


One long side of the oven is cut down the middle and along the dotted lines as shown. The two flaps are bent back to form the oven doors. A layer of sand is placed at the bottom of the oven floor. This will hold in the heat and spread it evenly all the way across the oven.

The oil tin oven is placed on bricks or stones and the fire is l underneath. The fire can use wood or charcoal. For a higher he a fire can also be made on top of the oven.



Adapted from: World Neighbours newsletter; VITA Village Technology Handbook.

A Simpler version of the Tin Oven

A tin drum is cut in half or to the height you want for the oven.

A layer of sand is placed at the bottom of the tin. Four empty tin cans are placed in the oven to hold the pot or baking tin.

A piece of wire is placed over two large stones to hold the oven, and a wood or charcoal fire is lit underneath. A sheet of tin covers the oven and a fire can be lit on this for extra heat.

Oven used by Maggie Vuadreu, YWCA worker, Nadarivatu Forestry Station, Fiji.

C. SMOKELESS STOVES

The following are models of smokeless stoves used in other countries. Full instructions for making the stoves are not given here but addresses for where you can get this information are listed at the end.

What is a smokeless stove?

A smokeless stove works by 1) controlling the air supply to the fire so that that the fire burns well and can be controlled, 2) carrying smoke away from the fire through a chimney or funnel.

Smokeless stoves burn better, use up less firewood and can use a number of different fuels, such as grass, rice husks, charcoal. They also reduce the time spent cooking.

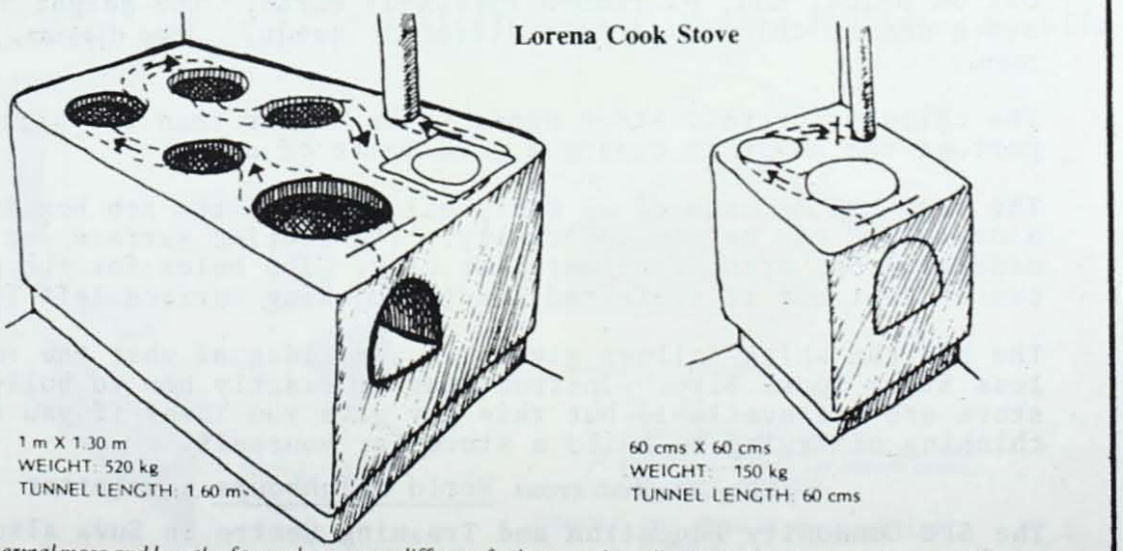
1. The Lorena Owner-Built Stove (Guatemala)

This stove is made out of sand and clay, tin cans.
Tools: shovel (spade), machete (bush knife), spoon.

The stove can be built on the ground or be built on a base to make it higher up. The stove is built up gradually, using the sand. The clay and water (or cement and water) hold the sand together. Pot holes are made for the pots and a tunnel made for the draft of air which will control the fire. There is a chimney to take away the smoke.

A sunken tin can placed just before the chimney is used for heating water. The water in the can is heated by the hot smoke just before it goes up the chimney and cools.

Fuel: The stove can use sugar cane waste, rice hulls, bark, cornstalks, sawdust, woodshavings and paper, as well as wood and charcoal.



The thermal mass and length of tunnels are very different for large and small stoves. Larger stoves have much longer tunnels and much greater heat storage capacity due to extra weight.

For information of how to make the stove, a construction manual is available:

Lorena Owner-Built Stoves by Ianto Evans.
Editors: Jim Kalin and Ken Darrow, 1979.

Available from: Appropriate Technology Project/Volunteers in Asia, P.O. Box 4543, Stanford, California 94305, USA. Price: $US 3.00 plus $US 1.70 for airmail postage.

A women's group could buy the book and share it, if your are interested in making the stove. If it is difficult to read, ask for help from someone who is good at reading plans.

The pot fits snugly in the pot hole of the stove.
The passage at the right carries the smoke away.

From: Soft Energy Notes, V111, Vol. II
December, 1979.

2. Smokeless Stove (Brazil)

This is a smokeless stove commonly used in Brazil. It has space for an oven if this is wanted. The stove can be made at home, out of brick, mud, or rammed (pressed) earth. The height of the stove can be changed to suit different needs. *(See diagram, next page.)*

The chimney for this stove needs to be higher than the highest part of the house to create a good draft of air.

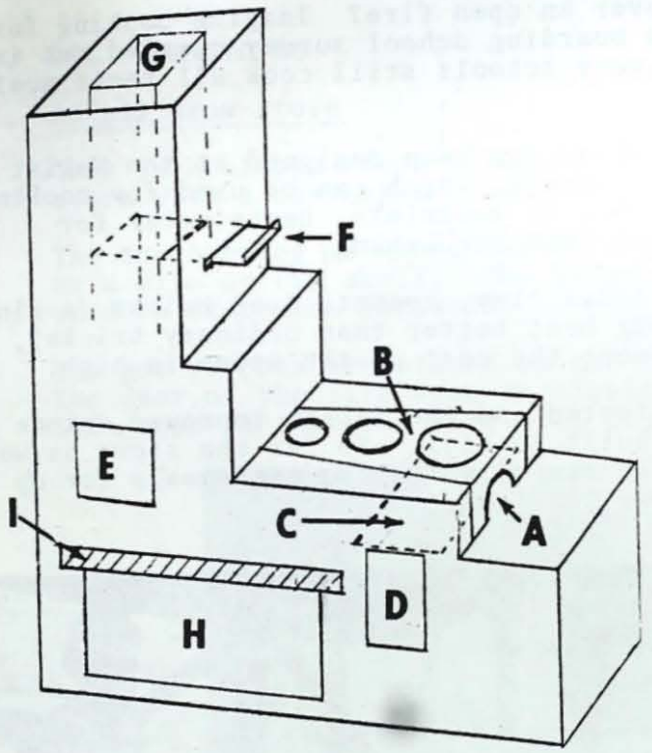
The oven can be made of an empty oil tin. If the ash box is like a drawer it can be emptied easily. The cooking surface can be made of iron, a sheet of metal or clay. The holes for the pots can be left out if preferred and the cooking surface left flat.

The diagram which follows gives you some idea of what the smokeless stove looks like. Instructions on exactly how to build the stove are not available but this may give you ideas if you are thinking of trying to build a stove for yourself.

Adapted from: World Neighbours newsletter

The SPC Community Education and Training Centre in Suva alsohas an instruction sheet on how to make a smokeless stove. Enquiries can be made to Naca Vosarogoci, Instructor in Rural Development, CETC, Box 5082, Raiwaqa, Suva, Fiji.

Smokeless Stove (Brazil)



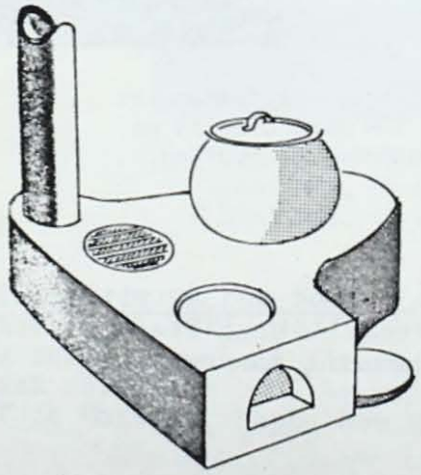
A. firebox
B. cooking surface
C. grate
D. deposit for ashes
E. oven
F. damper for heat control
G. chimney
H. deposit for storing extra fuel
I. wood or metal support

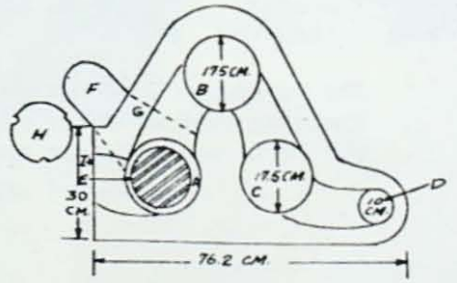
Illustration from: World Neighbours

3. Smokeless Stove (India)

This is a picture and diagram of another smokeless stove which will burn wood, charcoal, cow dung or other materials without smoking. The stove can be built outside and moved into the kitchen when it is set. It is made out of clay, straw or grass cuttings and uses tiles for the chimney (or tins joined together can be used). An iron grate for the fuel, and rings for the pots can be added.

The stove is 30" x 30" and is quite easy to move inside or outside. Because it is smokeless, it can be used inside.





A, B, C. POT SEATS
D. CHIMNEY BASE
E. GRATING
F. ASH REMOVING PIT AND ADDITIONAL AIR VENT
G. DAMPER THROUGH CHOOLA WALL
H. CHARCOAL STOVE ON FLOOR LEVEL FOR ROTI BAKING
I. FUEL ENTRANCE

FIGURE 2. TOP PLAN OF THE SMOKELESS STOVE.

From: VITA Village Technology Handbook, which gives details of construction or see Smokeless Kitchens for the millions by S.P. Raju, The Christian Literature Society, Post Box 501, Park Town, Madras 3 India. (1966)

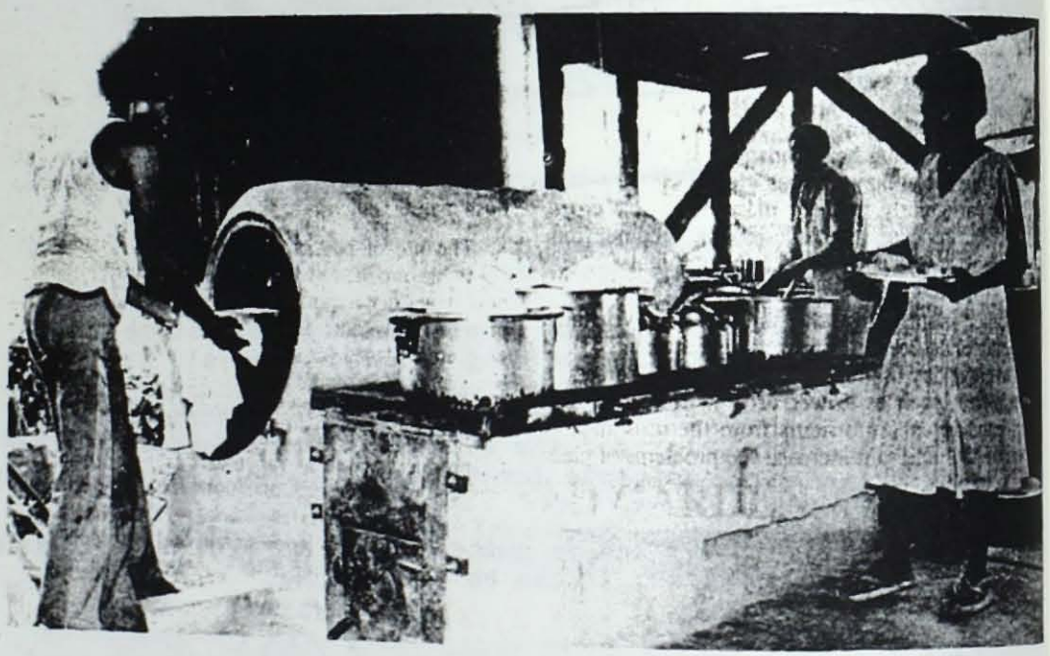
4. A Smokeless Woodburning Stove suitable for Schools (Fiji)

Cooking for your family over an open fire? Imagine cooking for a school that way! Yet a boarding school survey carried out in Fiji in 1977 showed that many schools still cook all their meals over an open fire.

A smokeless wood burning stove has been designed at the Marist Training Centre, Tutu, in Taveuni, which can be used for cooking school meals. It saves fuel, is smokeless, heats water for washing and also has a drum oven for baking.

The stove is built using local clay, cement, oven bricks (a kind of brick which holds strong heat better than ordinary bricks), and cast iron. At the moment the cost of the stove is high.

The stove is still being tested and the design improved, since it is the first of its kind built in Fiji. So far the stove is working well. A picture of the stove, which can cook meals for up to 50 persons, is shown below.



The Smokeless wood burning stove in use at the Marist Training Centre, Tutu, Taveuni. The drum oven is on the left, on the right are the burners for cooking.

From: Fiji Food and Nutrition Newsletter, 1981.
(including photograph)

D. OIL DRUM STOVES

1. An oil drum stove

This is a simple stove to make. A oil tin drum is made into a stove with a chimney to draw away the smoke.

The top opening is where the fire is lit. The fuel is placed on a wire or tin shelf. The larger opening at the bottom is used to store the firewood.

The pot or pots are placed on the top of the drum for cooking. The door of the fire area is closed to hold in heat or it is left open so that the fire will start well.

Oil drum stove. Chimney carries away the smoke.

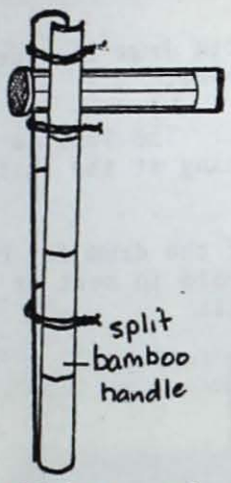
Oil drum stove used by Maggie Vuadreu, Nadarivatu Forestry Station, Fiji.

The South Pacific Appropriate Technology Foundation (SPATF) have a small book on how to build an oil drum stove which uses a small amount of firewood but produces a lot of heat. You can ask about the book by writing to: SPATF, Box 6937, Boroko, Port Moresby, Papua New Guinea.

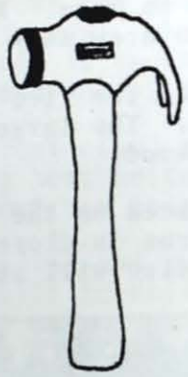
2. A drum oven

How to make a drum oven

Tools: cold chisel



large hammer



cutters

hacksaw

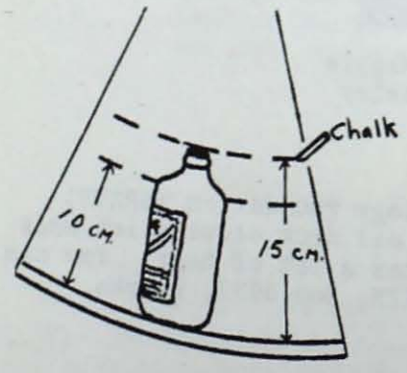
small beer or lemonade bottle for measuring, spade, chalk or soft stone for marking, long piece of string, bucket.

Materials:

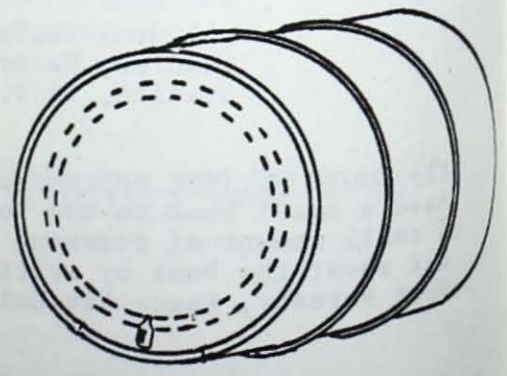
two large oil drums (one must be in good condition with no leaks and no large dents)
one piece of stove pipe (about 6 feet long)
three bags of cement powder
fine clean sand
rocks
water
chicken wire (2 metres x 1 metre or 6ft. x 3ft.)
a board (for back of the oven)
a tin with small holes at the bottom
a few nails and a small piece of scrap wood (for door).

How to make a drum oven

1. Take the drum that is in good condition. Using chalk or a soft stone, mark two circles on the end of the drum. Make one circle about 10 cm (4") from the edge of the drum. Make the other circle about 15 cm (6") from the edge. Use the bottle to measure as shown.

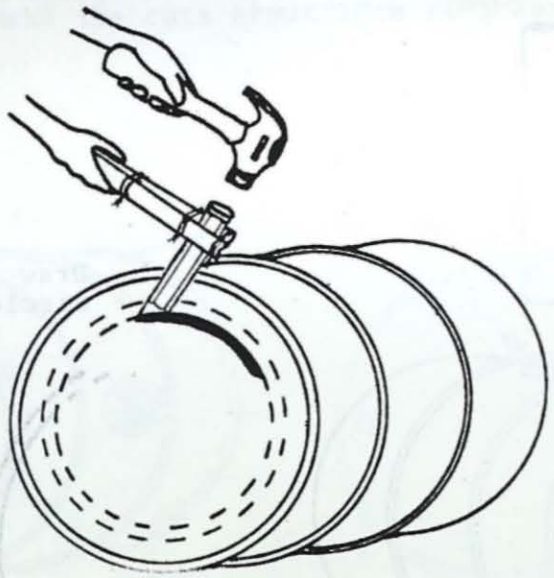


Beer bottle used for measuring 10cm and 15cm.



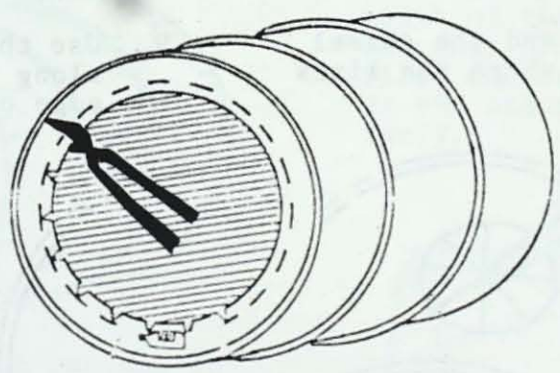
Two circles made at the end of the drum.

2. Carefully cut out the smaller circle using the hammer, chisel and chisel holder.



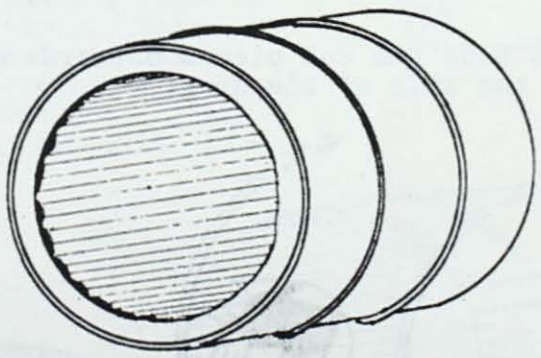
Cutting the inner circle.

3. Use the cutters to make cuts along the edge to the mark of the big circle. Make the cuts about 10 cm (4") apart. Do not cut further than the big circle.



Making cuts.

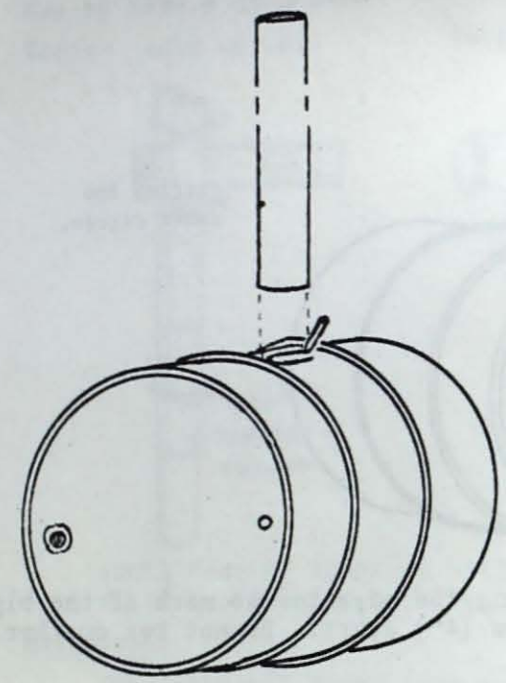
4. Use a hammer to bend the cut pieces inwards. Make a SMOOTH EDGE with no sharp points.



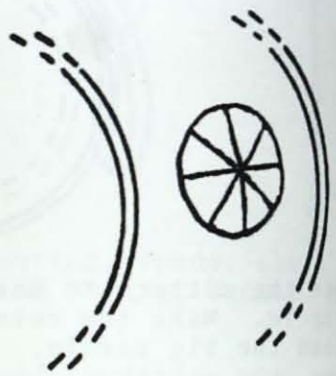
Bend and cut pieces inwards.

5. Burn off any oil left in the drum. Light a fire inside the drum and roll it carefully to burn off the oil on all sides. When the fire is out and the drum is cool, wash it out with water.
WARNING: If the drum has PETROL in it, DO NOT BURN IT OUT. Wash it out with water.

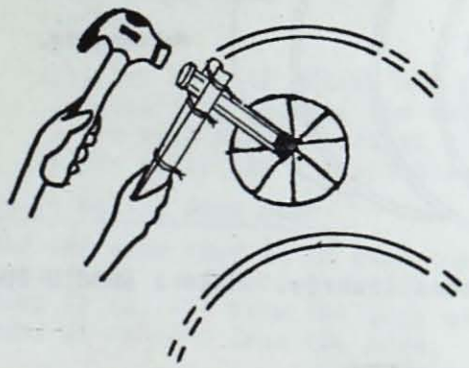
6. PREPARING THE OUTER DRUM: Take the other drum. In the middle of the drum, draw a circle the same size as the stove pipe.



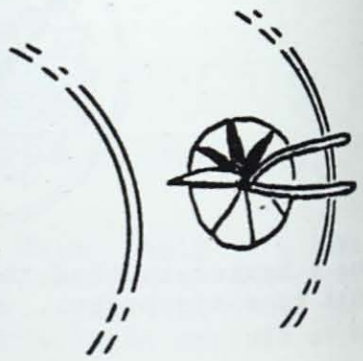
7. Draw lines in the circle like this.



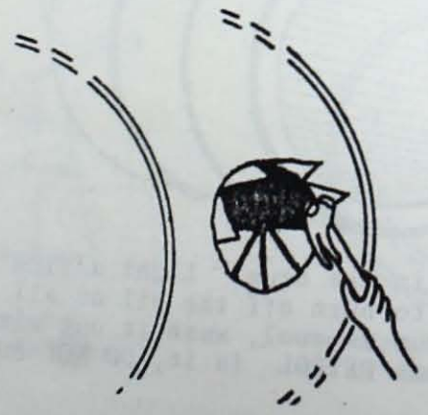
3. Use the hammer and the chisel to make a hole where the lines meet.



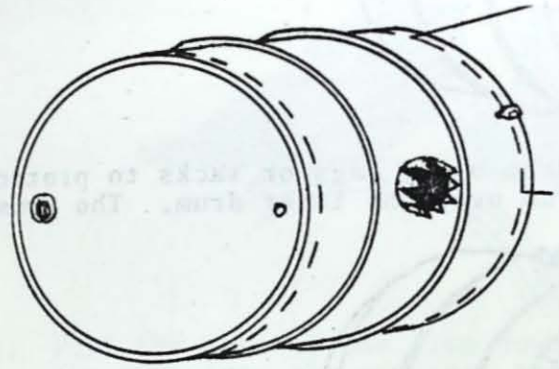
9. Use the cutters to cut along the lines to the edge of the circle.

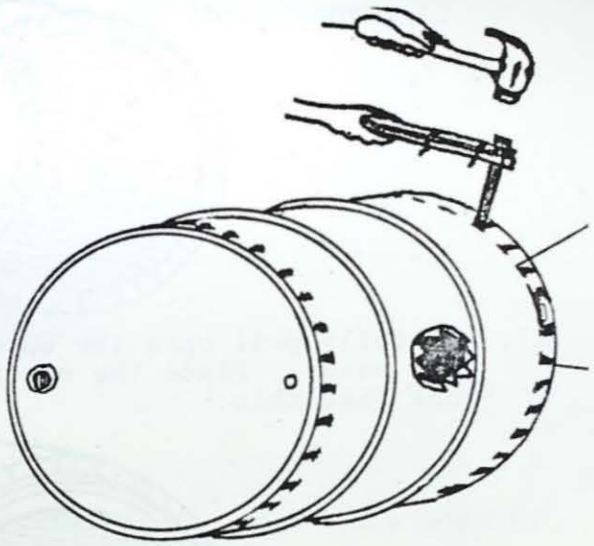


10. Use the hammer to bend the cut pieces outwards so that they stand up straight from the side of the drum.

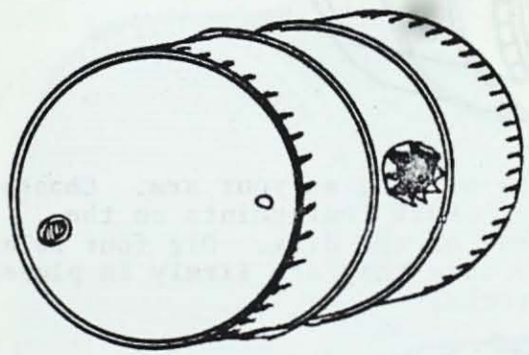


11. Mark two lines around the drum, 10 cm (4") from each end. Use the hammer and cold chisel to make cuts from these lines to the edge of the drum. Make the cuts about 10cm (4") apart.

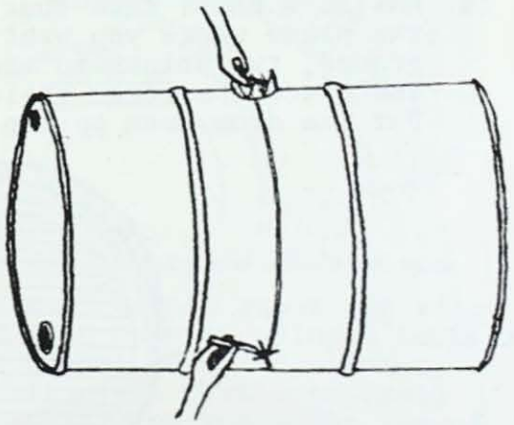




12. Now the drum looks like this.

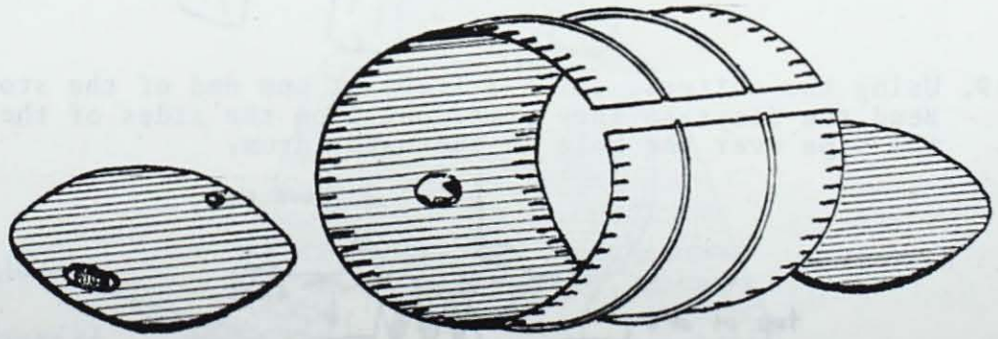


13. Find the spot exactly opposite the chimney hole. Measure the width of the drum with string and cut. Fold string in half. Place one end at chimney hole. At the other end, mark with chalk.

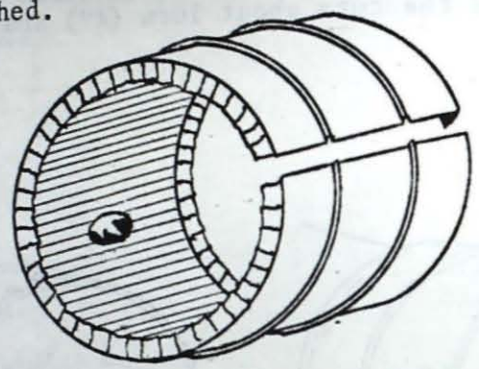


14. Cut the drum from one end to the other through this mark.

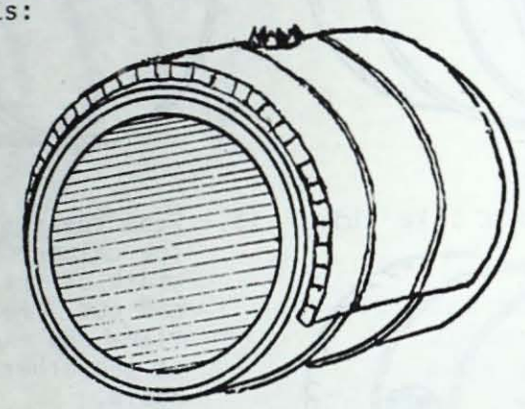
15. Use the hammer and chisel to cut around the outside edge at each end of the drum. Take off both ends of the drum. Save these ends. One will be used later for the oven door. Now the drum should look like this:



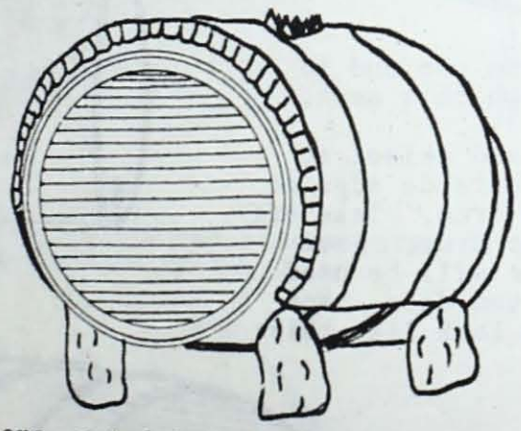
16. Use a hammer to bend the CUT ENDS of the drum inwards. Bend them-so that they form a ledge or rim. Now the outer drum is finished.



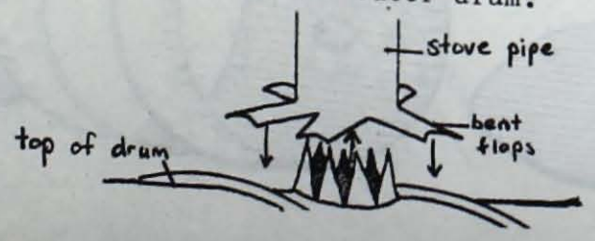
17. Carefully pull open the outer drum using rags or sacks to protect your hands. Place the outer drum over the inner drum. The drum look like this:



18. MAKING A BASE: Find four big rocks as long as your arm. Choose the place where you want the oven. Mark four points on the ground, two points to meet each end of the drum. Dig four holes and place the rocks inside. Make sure they are firmly in place. Put the drum oven on top of the rocks.

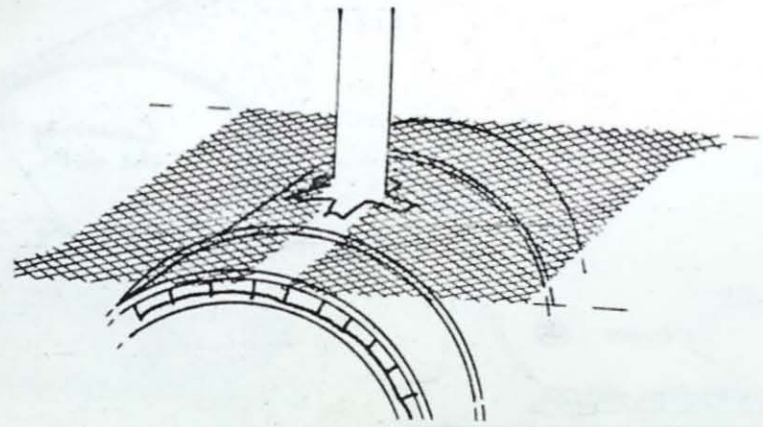


19. Using the cutters, cut 6-8 flaps at one end of the stove pipe. Bend the flaps so they stand out from the sides of the pipe. Put the pipe over the hole in the outer drum.

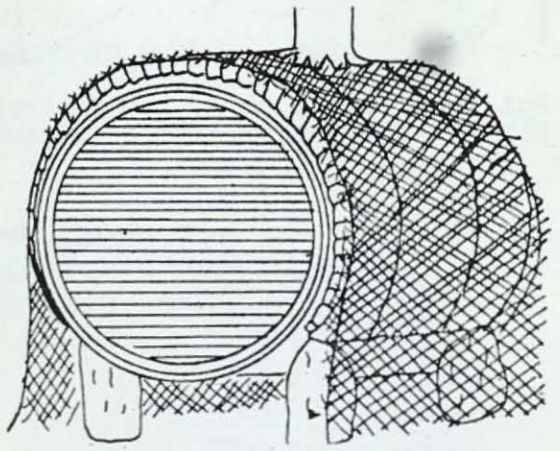


20. FINISHING THE OVEN: Use the chicken wire and cement. First, cut a piece of chicken wire that will cover the drum oven from the base of one side to the base of the other side. In the MIDDLE of the chicken wire make a cut half way across for the chimney.

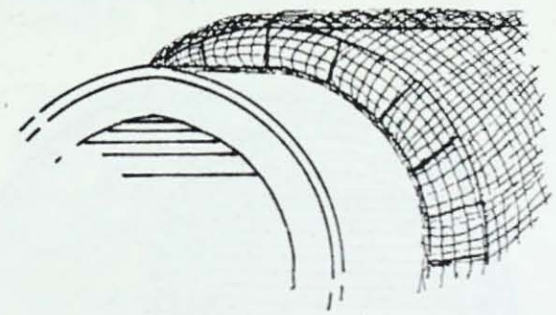
21. Fit the cut part of the chicken wire around the chimney.



22. Pull the rest of the wire down over the drums. Fold the edge of the wire into the openings between the two drums.

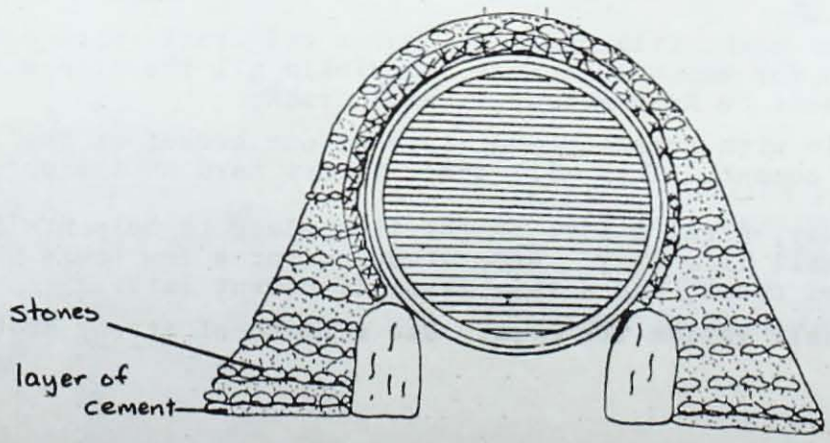


Covering the drum

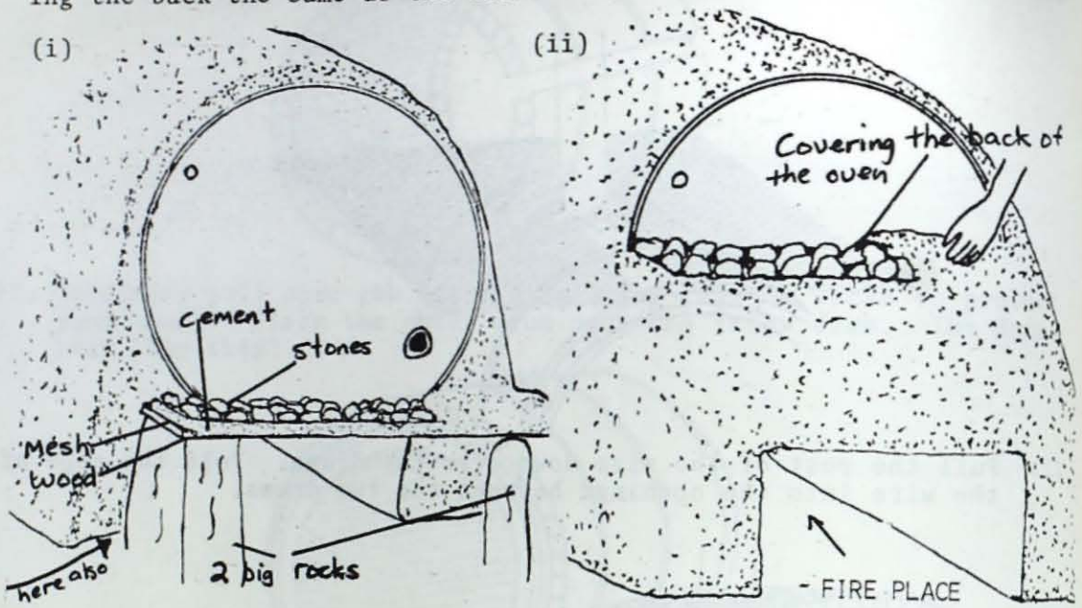


Folding the edges of wire

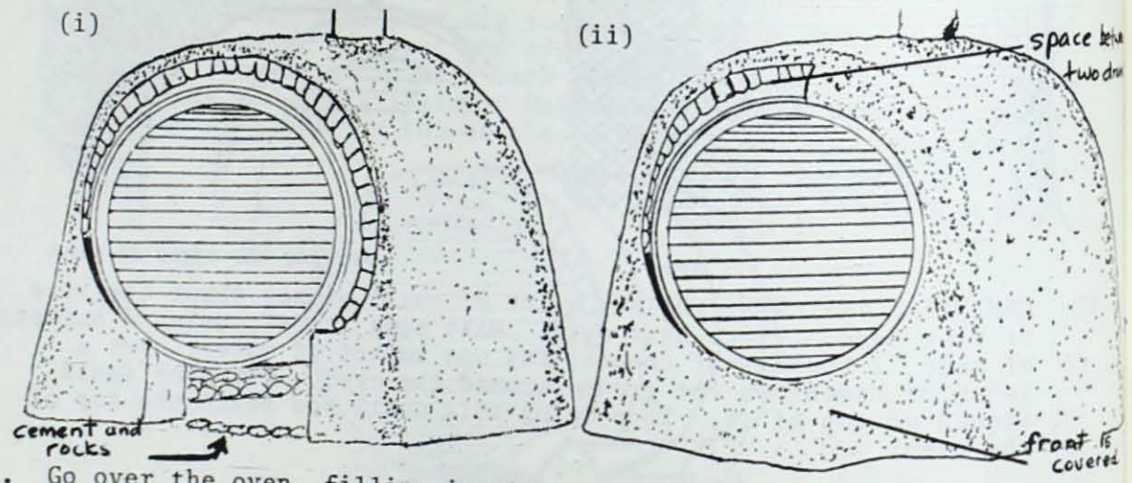
23. CEMENTING THE OVEN: Collect a lot of small stones about the size of your hand. Place near oven. Make some cement, using 4 buckets of sand, 2 buckets of cement, and one bucket of water. Put a layer of cement on the ground around the oven. Put some small stones on top of it. Keep doing this until you reach the top of the oven.



24. CEMENTING THE BACK OF THE OVEN: Find two big rocks. Place them at the back of the oven. Place a piece of wood on top of the rocks. Cover with mesh. Put cement and rocks on board and at base, covering the back the same as the front of the oven.



25. FINISHING THE FRONT OF THE OVEN: Put some cement and rocks to cover the front end of the fireplace. Fill in the space between the two drums.



26. Go over the oven, filling in all holes and cracks with cement. Leave oven for one week to set. Sprinkle all the time with water - the oven must be kept wet or it will crack.

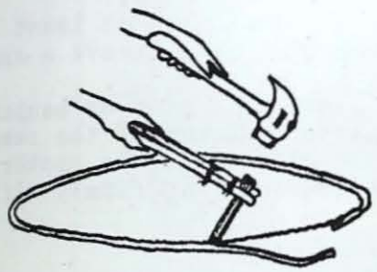
27. Cover again with cement - a mixture of one bucket of sand, one bucket of cement. This will make it very hard on the outside.

28. The next day, light a fire in the fire place to help dry the oven. Build a small fire only. Keep it going for a few hours. If the cement does crack, add a thin layer of cement later.

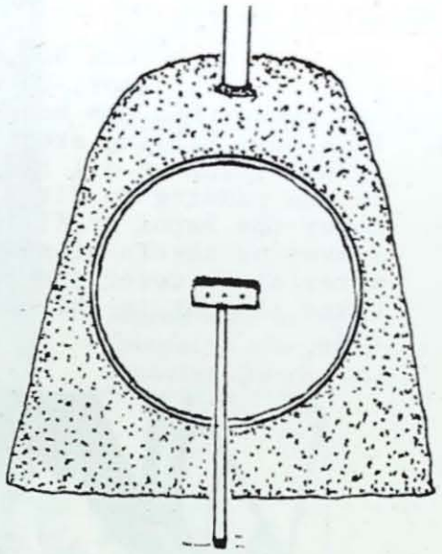
29. Place a shelf inside the oven. Use a piece of strong mesh or

two or three stones to hold the pots. The pots cannot sit on the bottom of the oven or they will burn.

30. MAKING A DOOR: Take one of the ends of the outer drum that were cut off. Use a hammer and chisel to cut off the edge of the piece. Hammer the piece flat. Nail a small piece of wood in the middle of the drum. Use a stick to hold the door in place when cooking.

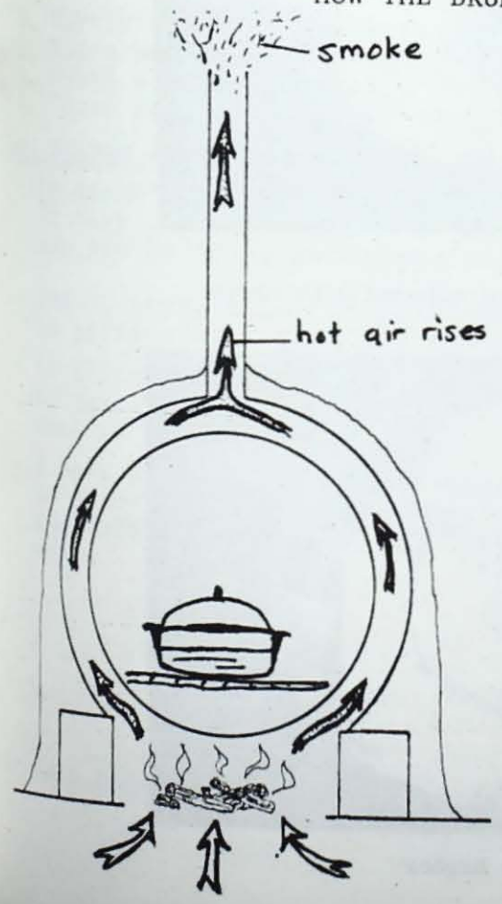


Cutting the edge off end.



Door held in place with stick.

HOW THE DRUM OVEN WORKS



The fire heats the air in the firebox.

This hot air rises because it is lighter than cold air. The hot air and the smoke move up around the inner drum.

The outer drum and the cement covering keep the hot air next to the inner drum. The inner drum gets hot and heats the oven. This cooks the food.

The rocks in the base and the cement around the drums hold the heat from the fire for a long time. The food in the oven will continue to cook for some time, even after the fire has gone out.

Adapted from:

A Drum Oven, Revised edition 1980, South Pacific Appropriate Technology Foundation, Box 6937, Boroko, Papua New Guinea.

Drawings: D. Sangwine.

E. THE HAYBOX OR FIRELESS COOKER

The haybox is easy to make and can cook food which has been heated already on a stove or fire. The haybox uses no wood or fuel, and saves energy. It keeps food cooking through the heat stored in the box by the packing materials, which act as insulators.

How to make a haybox

1. Use a large wooden box, bucket, kerosene tin, or pot or basket.
2. Fill in with kapok, coconut fibre, dry grass or sawdust or newspaper that has been cut up into small pieces.
3. Pack this filling around the box. It should be at least 3 inches thick on all sides, including the top. Leave a space in the padding to fit a pot.
4. Cover the kapok or filling with a piece of cloth or banana leaves or sheets of newspaper. Make a padding of the same fill material to cover the pot when it is placed in the cooker. Place the pot in the haybox and cover, closing firmly with a lid.

Basket filled with kapok and covered with cloth.

Pot placed in haybox

Haybox with lid. When the pot is closed, more filling is placed on top, and the lid of the haybox added.

The pot is left in the haybox overnight or for 5-6 hours, to cook.

Haybox made at SPC Community Education and Training Centre, Suva.

How to use the Haybox

The haybox works by holding in heat. It does not provide heat of its own. Food placed in the haybox must be heated first but this need only be for the few minutes. The food can then be placed in the haybox and some hours later, the food will be ready.

1. Partly cook or completely cook the food.
2. Place pot or dish (with a lid on), in the haybox.
3. Cover with more filling and close the lid of the haybox.
4. Leave all day or for 5 or 6 hours, to complete cooking.

Good things about the haybox:

It doesn't use fuel
It saves time. Instead of waiting for the meal to cook, you can be doing something else.

- Beans, peas, rice, dhal, stews - can be cooked in the haybox. It is particularly good for cooking meals that take time.
- If there is only one stove or burner in the house, one dish can be partly cooked and then placed in the haybox, while a second dish is cooked on the stove.
- A meal prepared in the morning can be left in the haybox and will be ready for the evening meal. A meal prepared in the evening and left overnight in the haybox will be ready for the morning meal.

From: World Neighbours newsletter
Mee Kwein Sue, formerly Principal,
SPC Community Education and
Traning Centre,
VITA Village Technology Handbook.

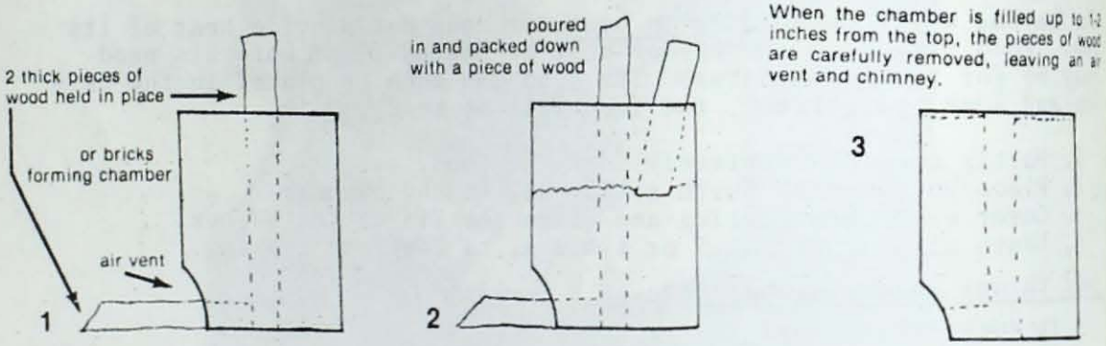
For more information: SPC Community Education and Training Centre,
Box 5082, Raiwaqa, Suva, Fiji.

F. SAWDUST BURNER

A stove using sawdust or coconut fibre, which will save fuel.

How to make a sawdust burner

1. Use a kerosene tin or other tin to make the stove.
2. Place two pieces of wood in the centre and bottom of the tin (make a hole at the bottom) and hold in place.
3. Pack the tin with sawdust or fibre, pressing down to pack firmly with another piece of wood.
4. When the tin is almost completely filled to the top, remove the two pieces of wood CAREFULLY, leaving an air vent and a chimney.
5. To light the fire, a narrow stick is dipped in kerosene, lit and pushed into the hole at the bottom. The stick must be only half the width of the opening to let enough air in to start the fire. The sawdust or fibre will begin to burn.
6. A cover is placed on top of the tin and stones used to hold the pot.
7. The stick is pushed further into the opening as it burns to keep the fire going.



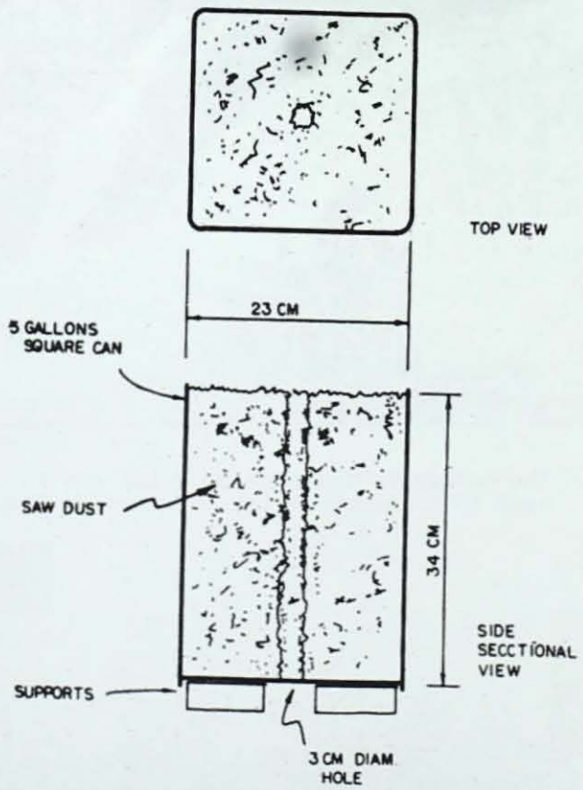
From: Simple Technologies for Rural Women in Bangladesh by Elizabeth O'Kelly, UNICEF, Bangladesh, 1978.

In Cold Weather or for Mountainous Areas:

A simple sawdust heater

1. Use a square can or tin.
2. Make a hole in the bottom to fit a stick. Fit the stick in in the hole.
3. Fill up the tin with sawdust. Pack it down well with a wooden stick and sprinkle with water.
4. Place the tin on some stones or bricks.
5. Take out the stick from the hole carefully, leaving a chimney.
6. Sprinkle some kerosene on top of the opening and light it.
7. The sawdust will burn for 6-7 hours. The rate of burning can be controlled by moving the bricks or stones underneath the can which cover the hole and let in more or less air.

A Sawdust Burner



From: Appropriate Technology, Vol 3, No. 2 Intermediate Technology and Development Group, 1976.

The energy behind flowing water can be used to transport water to where we want it.

WATER AND SANITATION

SECTION ONE - WATER

We all need water. We need water to drink. We could not live for long without water. We also use water for washing and keeping ourselves clean. This prevents us from getting skin diseases and other problems related to cleanliness.

We also need water to make our crops grow. Without water and sunlight we would not have food to eat. Water is also very important for irrigating our fields and gardens.

Having a clean water supply

Many diseases are carried by water and we must ensure that the water we drink is as clean and pure as possible. Getting water from a clean source may sometimes be difficult. Pumps can be used to transport water or to lift water up to where we want it. One of the easiest ways to get clean water is to collect rainwater. A lot of rainwater is wasted because often people do not collect enough of this water and prevent it running off into the ground. Corrugated iron tanks can be bought to collect water from roofs. These tanks may be expensive for some people to buy. We show here how you can make a similar tank using bamboo and cement. The cement may cost a little money, but the other materials for the tank can be collected from the bush.

We all need a good clean water supply for good health.

Water can be stored and used as needed. Simple filters can be made, above tanks or in the home, for filtering water and making it cleaner for drinking. This will not remove all disease carrying material from water but will remove eggs, insects, worms and other larger material. The water can then be boiled for pure safe drinking water or chemicals added to make the water safe for drinking.

Water is a very precious resource and must be used carefully. Some hydro-electric schemes which use water to generate electricity require

building a dam which will flood large areas of land, killing plant and animal life there. It also changes the flow of the river. Some water power schemes therefore change the environment in a big way and can do a lot of damage. The value of the electricity generated must be weighed up against the cost of causing damage to a water source which can never be undone.

The flow of water can be used to transport water over distances to where we want to use it. It is the fall of water which is used in large hydro-electric schemes to generate electricity. It is also possible to use the same power behind flowing water to make small hydro-electric plants which will give power to local areas.

Women and Water Supply

For women, fetching water, like fetching firewood, can take up a large part of their day. Where water is not easily available, women in some parts of the world have to walk long distances each day to collect water. They also sometimes have to collect water for gardens and fields. There are simple ways of moving water using pumps; wells or piped water can bring water close to where it is needed. Women's work can be made much easier by having water close at hand.

Sanitation

Sanitation and the clean removal of human waste is also important to health and is often connected to having a clean water supply. Water can easily be contaminated by wastes poured into it by factories and other industries which use the water to get rid of waste material. Human wastes carry disease and can spread through water also. It is important for people to have good toilets to contain these wastes.

Simple pit toilets can be built which get rid of human wastes but do not endanger the water supply. It is important that toilets be built well so that they are:

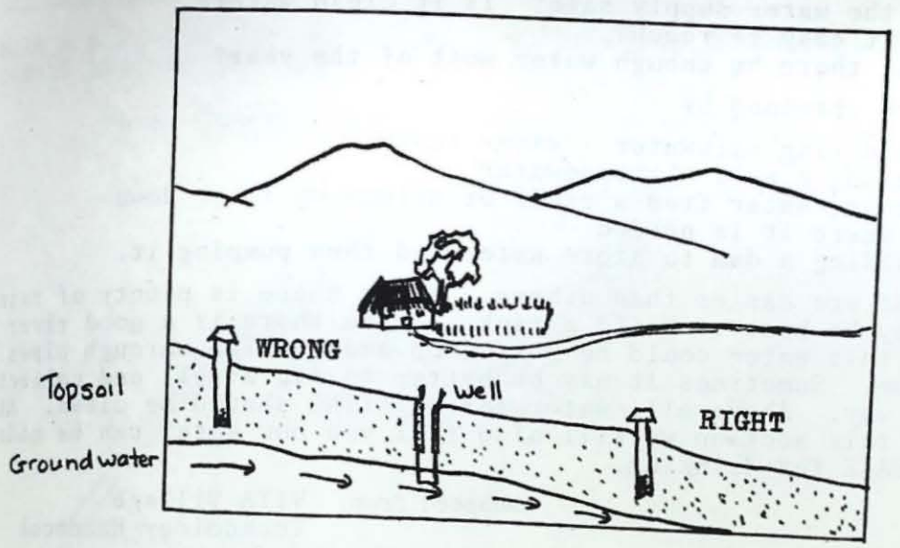
1. clean and do not transmit disease
2. do not go into the water supply system and spoil the water.

Water seal toilets are a better way of getting rid of wastes and should be built whenever possible.

Where latrines are built is very important. They must be close to the house so that people will use them and not instead go into the bush or use the ground. The water table or area where there is water underground can easily be contaminated by wastes from toilets seeping into it. We must be careful not to build our latrines above the area where we collect our water.

Latrines should be built not too far from the house but below the point where water is collected - that is, below wells, streams or rivers. If the latrine is built above a well for instance and the pit is too close to the water table, the wastes can seep into the groundwater and enter the drinking water in the well. *(See picture)*

WHERE TO LOCATE LATRINES



Direction of water flow underground

Good water supply and sanitation involves the community, because unless all households are involved in cleanliness and in having and keeping a clean water supply, disease will continue to spread in this way.

Having a good water supply available will often greatly help women with their work. It is hoped that the following section will provide some ideas on:

1. water and where it comes from and how it can be obtained;
2. purifying water and keeping it clean;
3. better sanitation

WHERE IS WATER:

1. On the surface - in rivers, streams, ponds and lakes
2. Underground. Water may not always be visible above the ground. Rainwater falls and seeps through the topsoil. The water can remain underground and stays in sand or certain soils. If it meets rock or stone, the water can move around it or under these materials. Water underground is called groundwater. The top of this water, that is where you would come to water if you dug underground, is called the watertable.

   The watertable is sometimes deep underground or sometimes not very far from the surface. Sometimes water comes to the surface as a spring or seeps up in a swamp. Wells can be dug or drilled down to this water and the water can be drawn up to the surface for use.
3. Rainwater. This can be collected and stored. In areas where there is plenty of rain, this is one of the best ways of getting a clean water supply.

Finding a good water supply

It is important to:

1. have water all the time;
2. have clean safe water;
3. have water that is not too far away.

When looking for a water supply it is good to ask -

1. Is the water supply safe? Is it clean water?
2. Is it easy to reach?
3. Will there be enough water most of the year?

Water can be obtained by -

1. Collecting rainwater - water tanks
2. Digging a well - groundwater
3. Pumping water from a river or stream up to or down to where it is needed
4. Building a dam to store water and then pumping it.

Some methods are easier than others. Where there is plenty of rainfall, it may be best to build a tank. Where there is a good river or stream, this water could be pumped up and carried through pipes to the house. Sometimes it may be better to dig a well and collect water that way. Above all, water for DRINKING should be clean. At the end of this section we will also tell you how water can be made clean and SAFE for drinking.

Adapted from: VITA Village Technology Handbook

A. RAINWATER

In many parts of the Pacific, there is plenty of rainfall for at least some parts of the year. This rainwater can be collected off roofs and other smooth surfaces and stored in tanks for use. In some areas where it is very wet and there is heavy rainfall, there is more than enough water to supply the needs of households. A great deal of water is wasted - water off large buildings, schools, water running along drains. If this water were collected and stored it could be used in times when there was no rain, or it could be used for watering crops.

The water in many towns is provided by a central water system - where water in large amounts is collected and properly filtered and cleaned for use in our homes. This is the water that we pay for.

In rural areas, people collect their own rainwater and store it, sometimes in small containers so there is never enough water. Tin tanks are another way in which water is collected. These are good but cost a lot of money. Here is a water tank which is built out of bamboo and cement and can be made using materials from the bush.

1. How to Make a Water Tank out of a Bamboo and Cement.

Materials:

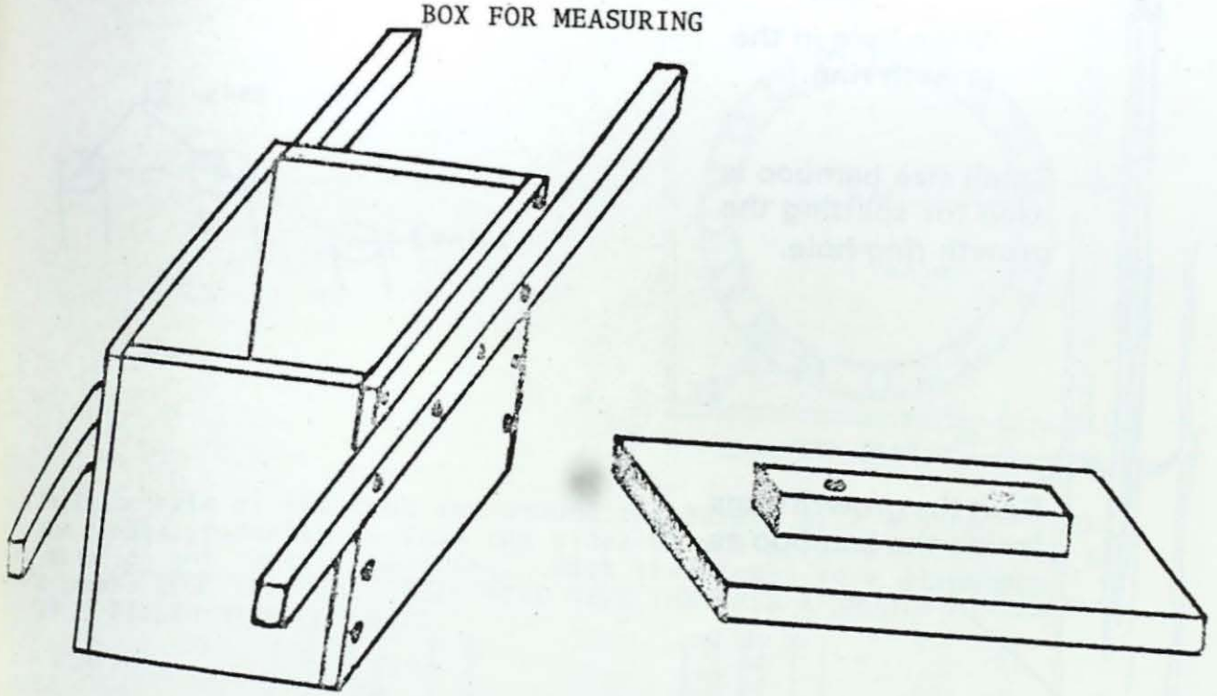
- 15 bags of cement
- 4 bags of lime (can be bought or made by burning coral (calcium carbonate) to a white powder, which is lime)
- 50 poles of bamboo - 15 ft. (5 metres) long and at least 4 inches wide.
- Cane for weaving (if not cane, use split bamboo for weaving.) The amount will be different depending on the size of the cane in your area. Collect plenty of cane and have it ready before plastering.

How to measure amounts to use:

Make a box like the one below. Use the box to measure concrete and cement plaster (mortar).

Note: Cement plaster or mortar is different from concrete.

BOX FOR MEASURING



Cement plaster or Mortar:
- 1 part cement
- ½ part lime
- 6 parts sand
- mixed with water

Concrete:
- 1 part cement
- 2 parts sand
- 4 parts gravel (small stones)
- mixed with water

Step 1

Collect bamboo from bush. Cut into lengths required - 15 ft long and at least 4 inches wide.

The growth rings inside each bamboo, which separate each section, will have to be broken.

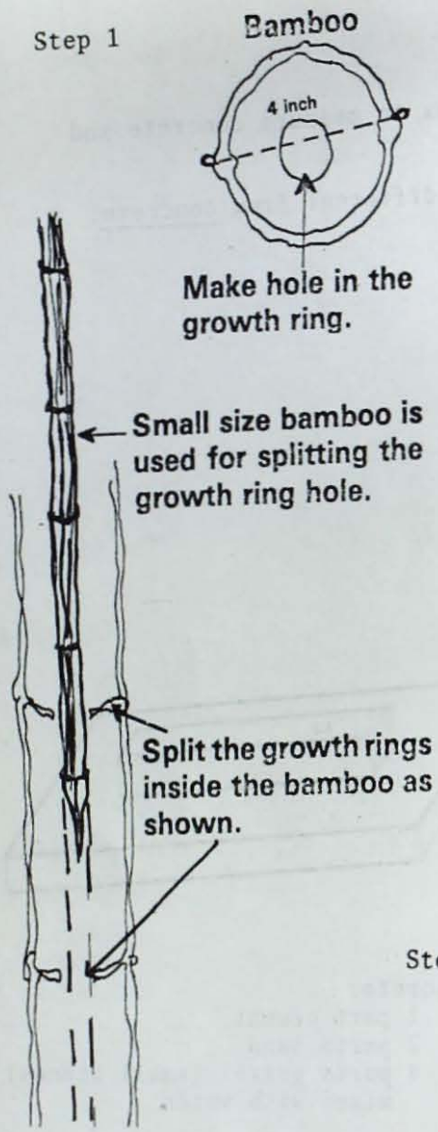
Make a small hole in the growth ring at the end of the bamboo. Get a small size bamboo. Sharpen one end. Use the small bamboo to split the growth rings inside the bamboo poles, as shown. *(See next page.)*

Step 2

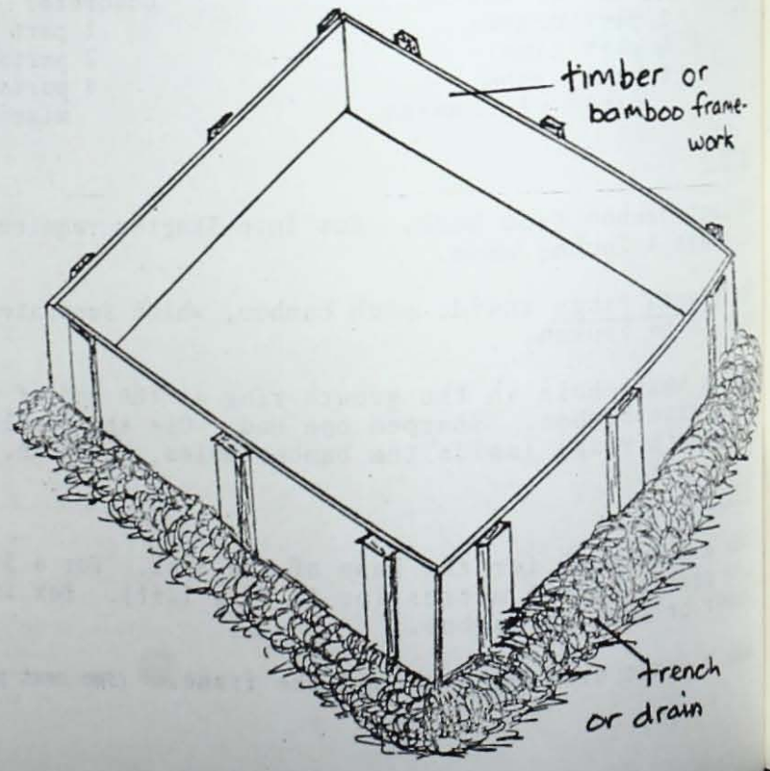
Make a framework for the base of the tank. For a 3 metre tank it is 3.66 metres x 3.66 metres (or 12 ft x 12ft). Box in the area with split timber or smaller bamboo.

Make a drain or trench around the frame. *(See next page.)*

Step 1



Step 2

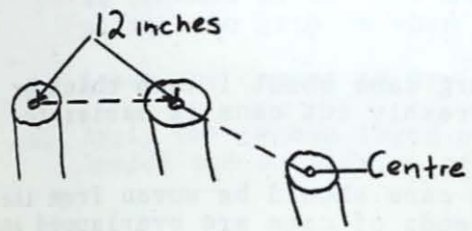


Step 3

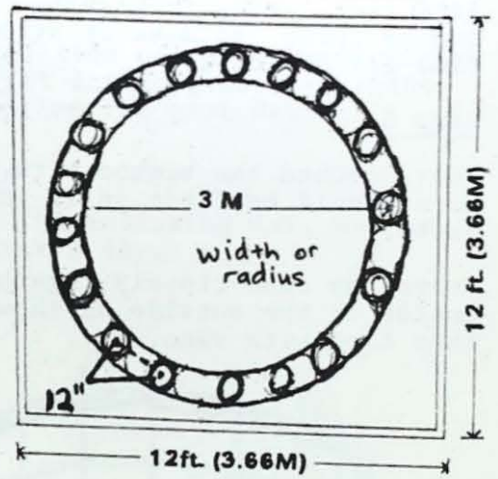
INSIDE the framework, plant the bamboo poles to the radius you want. That is, whatever size roundness you want the tank to be.

Make a distance of at least 12 inches from the centre of each bamboo pole to the centre of the one next to it, as shown.

Bamboo 12 inches apart

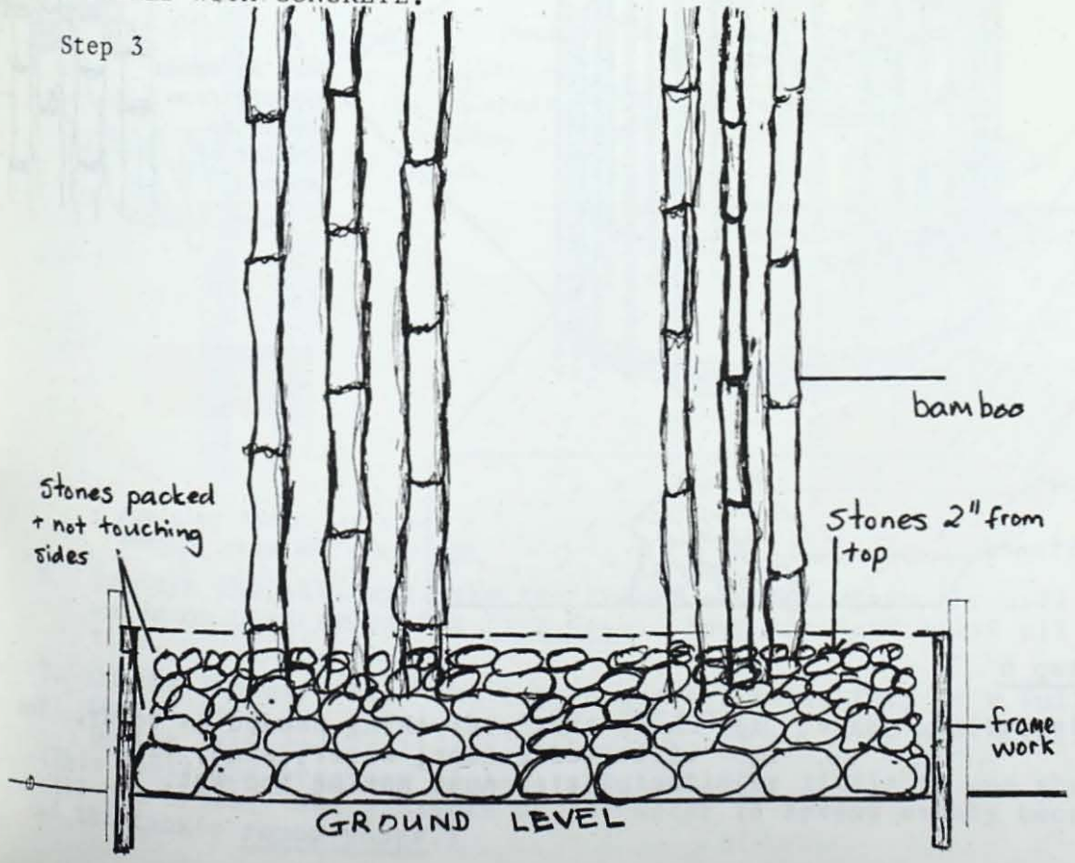


Bamboo planted in framework



Pack the base of the tank and around the bamboo with stones. Pack the stones gradually in from the sides of the framework, so that the stones do not touch the sides. Pack the stones to a minimum of 2 inches from the top. THIS WILL GIVE THE BASE A SMOOTH FINISH WHEN IT IS FILLED WITH CONCRETE.

Step 3



Step 4

Fill bamboo poles with very liquid concrete (that is, use a lot of wa See earlier for concrete mix. Tap sides of the bamboo to let the concrete go down the poles.

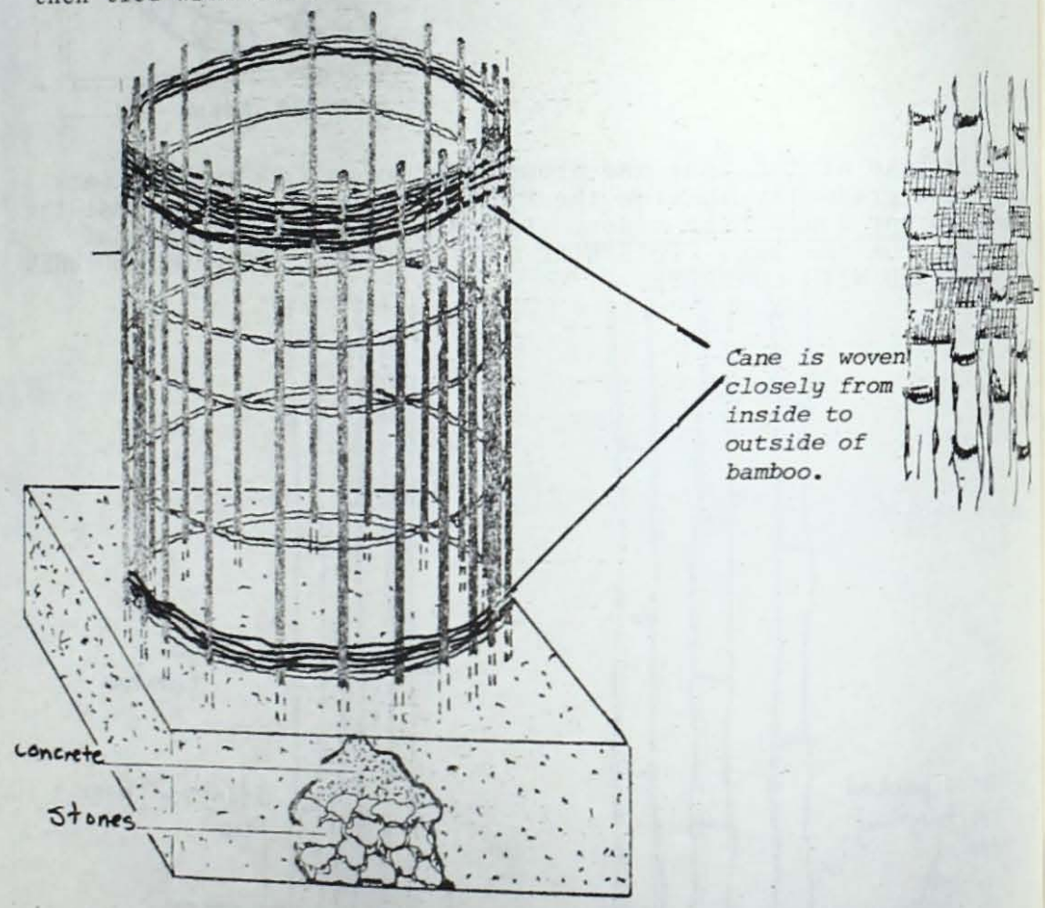
Fill concrete in floor base. Smooth top of floor base. Leave it overnight to set.

Take away timber framework. After the first 24 hours, the concrete can be cured (to make it stronger) by keeping the concrete WET all th time for 3-7 days.

Step 5

Weave around the bamboo with care. Big cane about 1 inch thick or more should be first split in two. Freshly cut cane is easier to weave.

Weave the cane closely together. The cane should be woven from the inside to the outside as shown. The ends of cane are overlapped and then tied with vine.

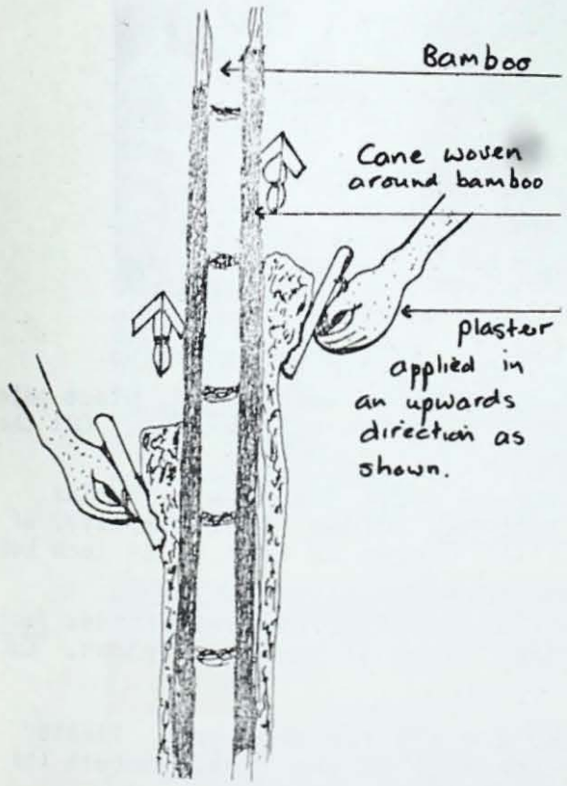


Step 6

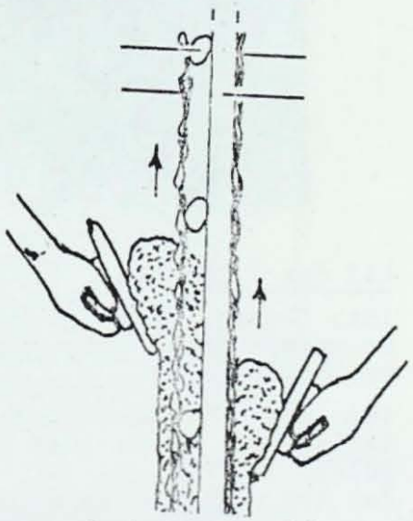
Plastering. Note: i) check that everything needed is ready. You will need cement, water, sand, lime.
ii) The plaster must not be too wet.

How to plaster the tank:

1. It is best to first take the mortar in your hand (mortar must not be too wet) and starting from the BOTTOM to the TOP - pack the mortar in between the cane ON BOTH SIDES. Start further out from the base and then work straight up, or the plaster will slip down again.
2. Go over it adding more plaster, using a trowel or piece of board and smoothing it down.
3. Make markings on the inside and outside of the plaster before it becomes hard. The markings will act as grooves for the plaster to grip on when it is applied the next day.
4. Leave the cement to dry for a day.
5. Apply the second layer of cement the following day, on the inside and outside. Let it dry for a day.



Applying first layer of cement, from BOTTOM TO TOP.



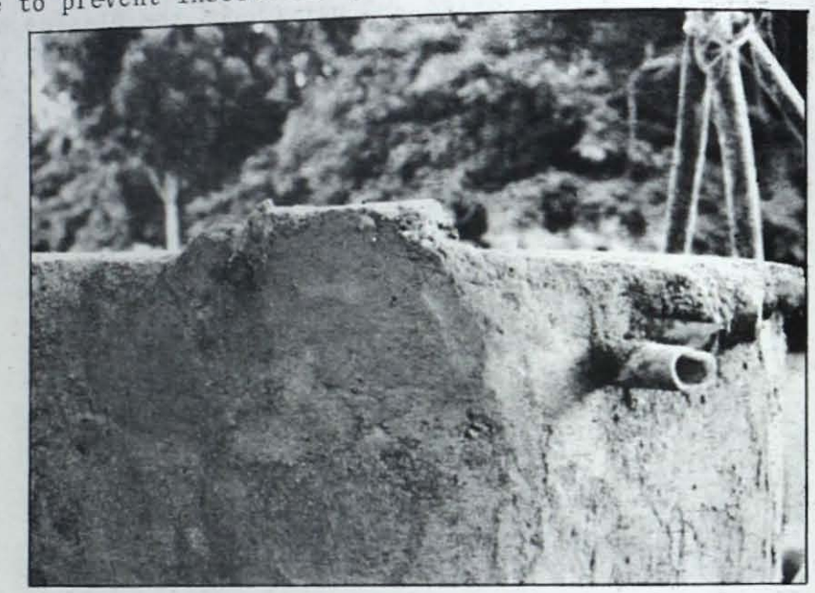
Applying second layer of cement.

6. To cure the wall and make the cement strong, spray the wall with water on both sides for five days. Keep the tank moist all the time.
7. On the 7th day, fill the tank a quarter full. Keep it ¼ full.
   On the 14th day, fill the tank to half full. Keep it at ½ full.
   On the 28th day, fill the tank to the top.
(This tests the pressure of the tank little by little to see that it will not break. The pressure of the water is spread evenly because of the tank's round shape.)

Step 8

Making a lid and overflow outlet. You will need: split bamboo poles
cement.

(a) Overflow outlet: Get a small piece of bamboo about 1 foot long. Split the growth rings. Place the overflow outlet on the top of the tank, half inside and half outside the tank. Hold in place with plaster and allow to dry. Screen with mesh or loose woven cane to prevent insects' entry.



At left - bamboo overflow outlet at top of tank.

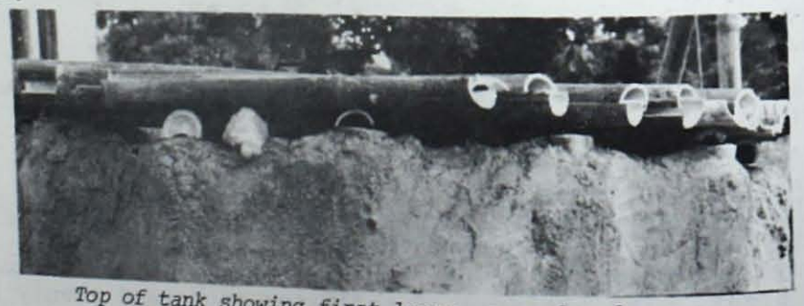
(b) Lid for tank: Collect bamboo poles. Split bamboo in two.

Ist. Layer - With inside of split bamboo facing down, place poles at intervals 6 inches apart across the top of the tank. Cut the bamboo to size.

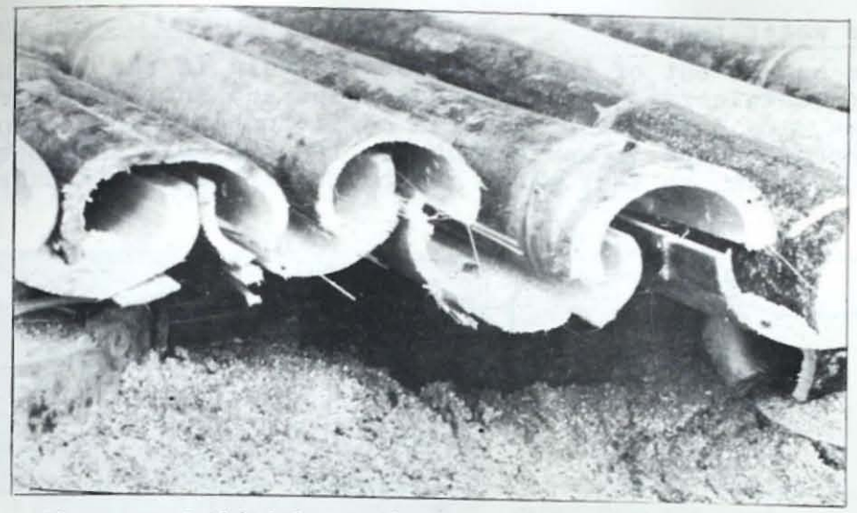
2nd layer - Place a second layer of split bamboo with inside facing up. Place them close together across the first layer of poles. At one end cut some of the pieces to make an 18 inch hole for the water to be collected.

3rd layer - Place a third layer of split poles with insides facing down in the grooves of the second layer of bamboo as shown. Cut to create hole.

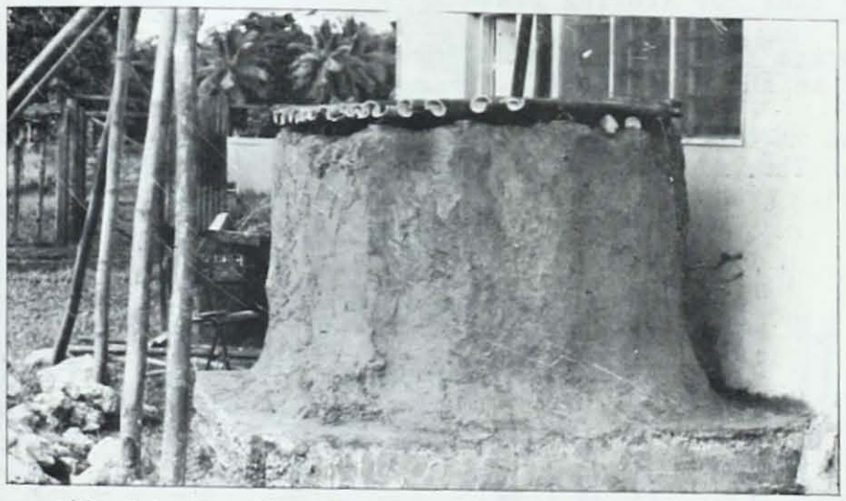
Plaster over the bamboo to make the lid for the tank. Plaster the space between the lid and the wall of the tank. Smooth the sides.



Top of tank showing first layer, second and third layer of split bamboo.



Close up of third layer fitting into grooves of second layer underneath.

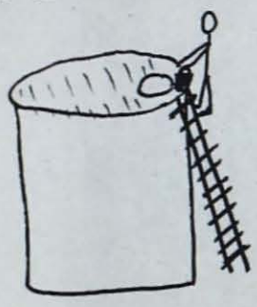


Lid of tank ready for plastering.

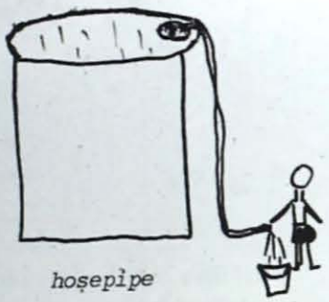
Close up of plaster covering lid of tank. Sides are also covered with plaster, joining lid to rest of tank.

Using the water tank

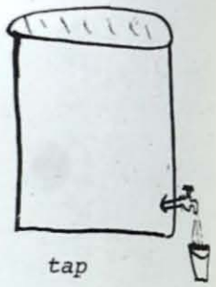
Water can be got out of the tank from the hole in the lid, using a bucket or container. Or using a hose pipe and suction to bring the water down. Or a faucet or tap can be fitted into the bottom of the tank before the cane is woven around. The tap must hang over the edge of the base, so that water can be easily collected underneath it.



bucket or container



hosepipe

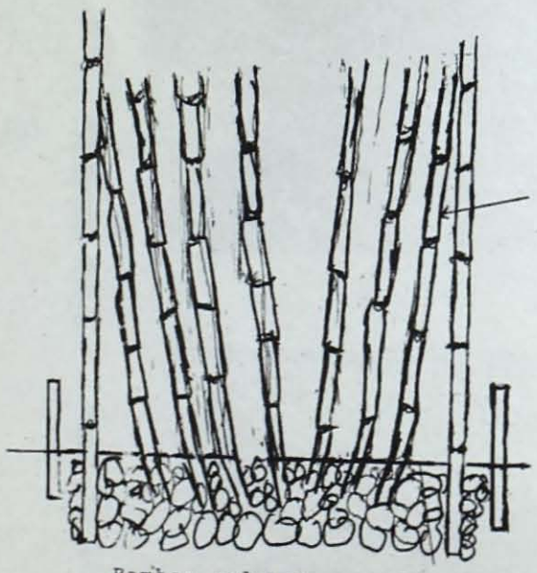


tap

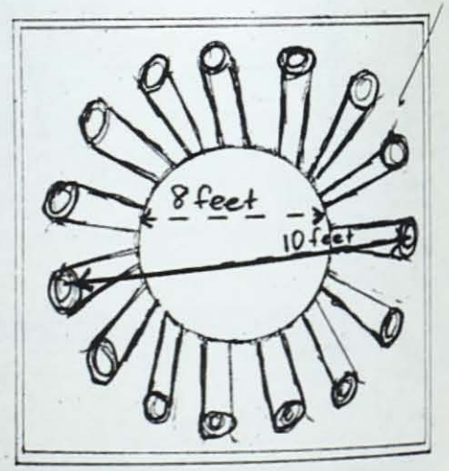
Using the tank for storing grain

Grain storage tanks can be made the same way only the bamboo poles are placed at an angle as shown.

The height is 3 metres or 10 feet; roundness at the top is 3 metres or 19 ft. The bottom is 8 feet in roundness because of the angle of the bamboo.



Bamboo poles at an angle.



Base is 8 feet, top is 10 feet in roundness.

Drawings: National Housing Commission *(adapted by editor)*
Photos: Dr. Pauulu Kamarakafego

Adapted from: How to build a Water Tank
Designed by Dr. Pauulu Kamarakafego,
Office of Village Development, Box 6937
Boroko, Papua New Guinea.

2. Other ways of collecting rainwater

i) Tin tanks

Many people have tin tanks for storing water. The water comes off the roof and down the drainpipe into the tank. The water is used from a tap at the side of the tank.

A tin tank for collecting rainwater.

The drainpipe carries water from the roof to the tank.

A tap at the bottom (left) lets out the water.

Repairing tin water tanks

If you have a tin tank which is rusty or has holes in it, don't throw it away. The tank can be repaired and made to last longer by covering it with a thin layer of cement.

HOW TO MEND A WATER TANK

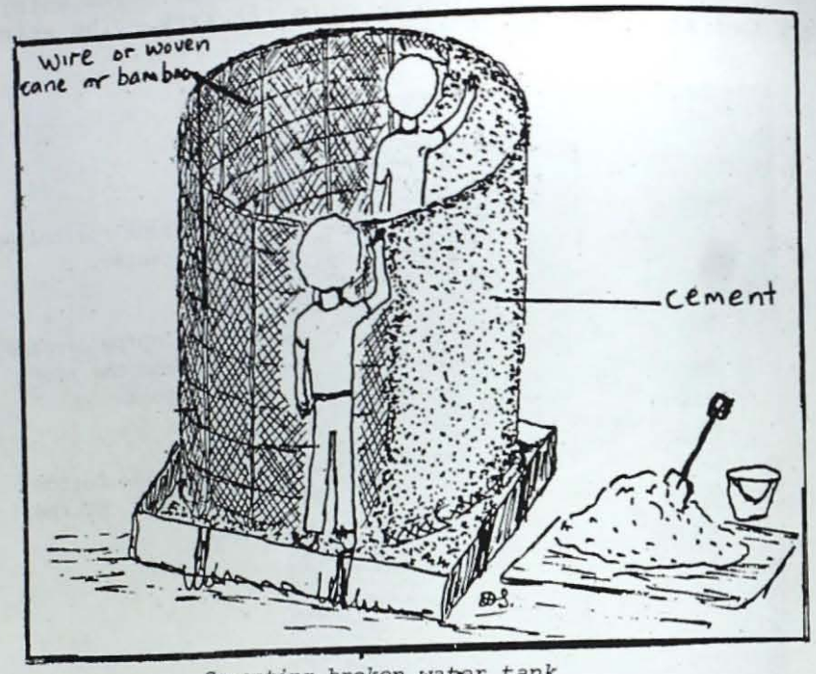
1. Cut out the top of the tank using a hammer and chisel.
2. Cover inside and outside the tank with a) wire mesh or b) woven cane or bamboo or c) using a hammer and nail, punch holes in the tin about 1 inch apart.

   This is to provide a grip for the cement when the tank is plastered.
3. Plaster the tank on the inside and the outside with cement with not too much water. *(See page 49 for cement mixture).* Cover with enough cement to make a smoothe surface.
4. Put in an overflow pipe. Place the cut out tin lid back on the tank after following step 2 above. Cover with cement also.

   or

   Make a lid for the tank out of bamboo and cement, the same way as was done for the bamboo and cement tank.

5. Put stones in the space between the lid and the top of the tank if using bamboo. Cement around the edges of the lid and the top of the tank to make a smoothe side.



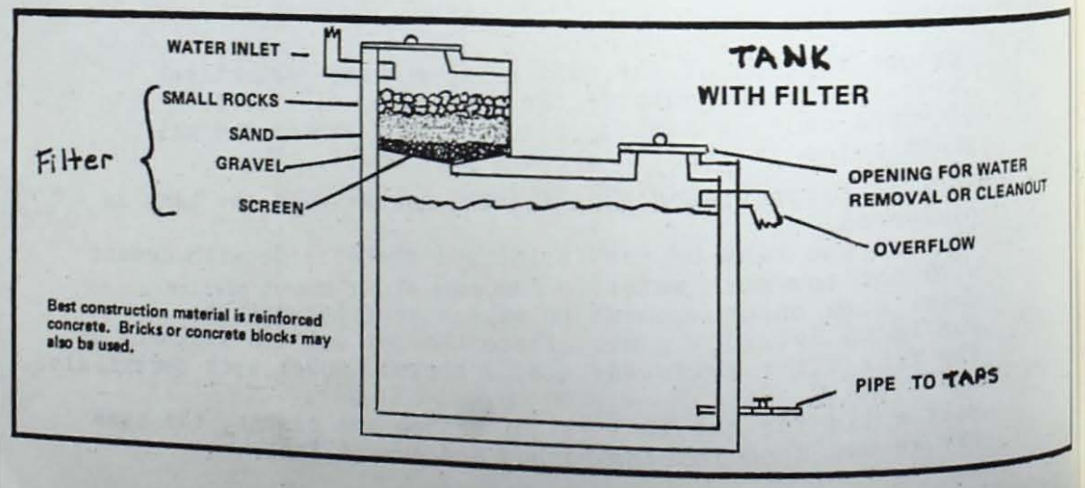
Cementing broken water tank

Adapted from: Yumi Kirapim, No.18, Office of Village Devt./ SPATF, Box 6937, Boroko, Papua New Guinea.

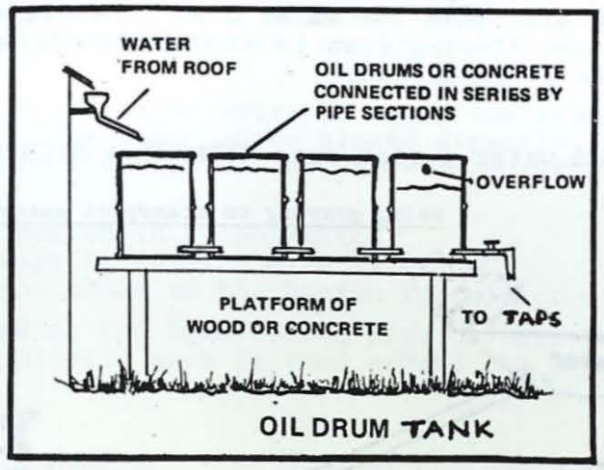
ii) Other tanks

Below the diagrams of three types of tanks which can also be used to collect rainwater.

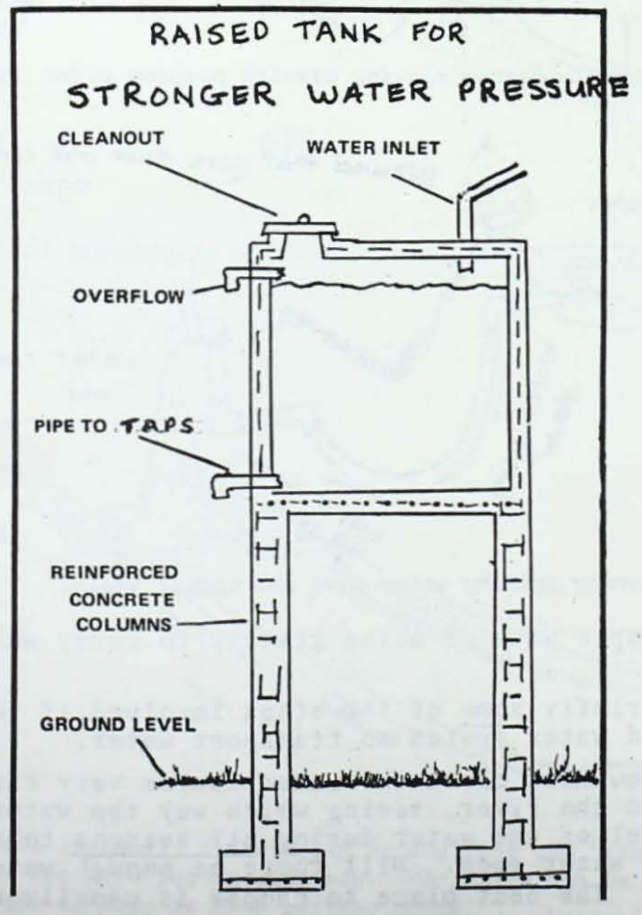
(a) Tank with filter on top. This cleans the water as it enters the tank. The tank can be built above ground or underground.



(b) Oil drum tank. A simple tank can be made by joining a series of empty oil drums. Connecting pipes can be welded into drums. The tank can be extended to any size, simply by adding to the number of drums to allow more water to be collected.



(c) Raised tank. By raising the tank, the water will flow by gravity to taps and showers which means that there will be more force or pressure behind the water when it comes out of the taps.



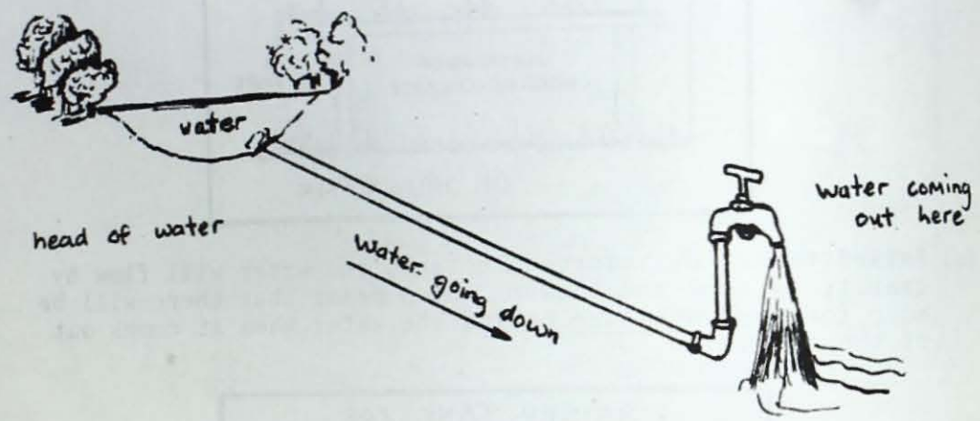
B. TRANSPORTING WATER

1. Gravity Feed Water System

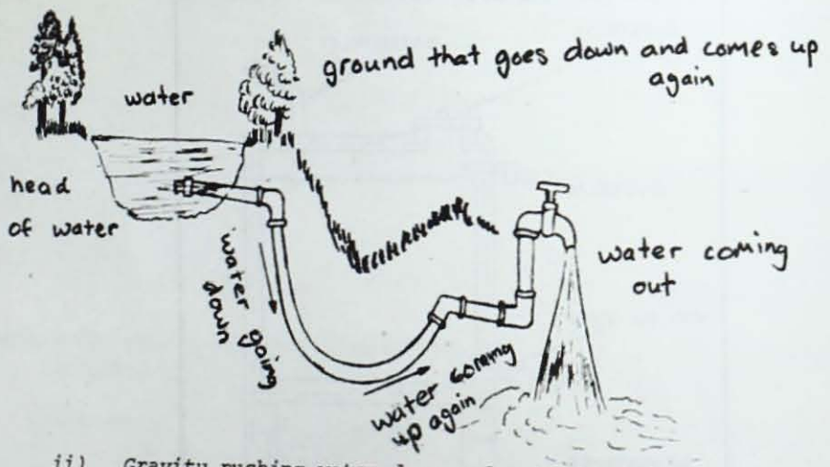
When the source of water is above us, such as in a spring or mountain stream, there is no problem getting the water down to us. Gravity which is the pressure which forces everything to be weighted down to earth will push the water down to where we want it. The gravity of water flowing down is strong enough to push water uphill again to where it is needed.

A gravity feed water system runs WITHOUT A MACHINE and USES NO FUEL.

Using gravity to transport water



i) A simple system showing gravity pushing water downhill.



ii) Gravity pushing water down and uphill again.

These are simple ways of using gravity to carry water to where you want it.

These are briefly some of the steps involved if you wish to use a gravity feed water system to transport water.

1. First you must check the water source very carefully. Go up and down the river, seeing which way the water falls etc. Watch the level of the water during all seasons to see how high and low the water goes. Will there be enough water all the year around? The best place to choose is usually a mountain river or stream, particularly where there are falls or deep pools.

2. You will need some kind of piping. If buying from the shop, plastic piping is best. It is light in weight and is cheaper and easier to carry.

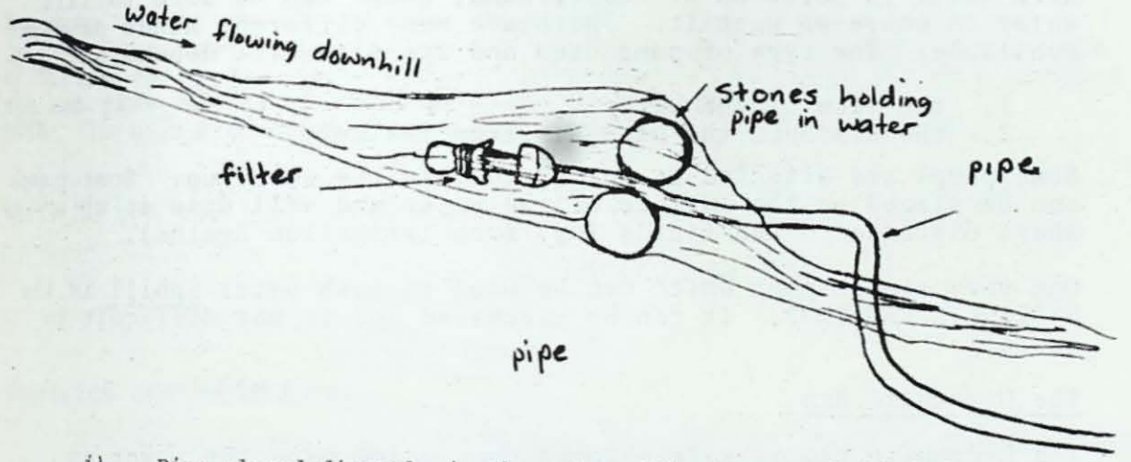
or

Split bamboo or whole bamboo can be used for piping. The dividing sections of the bamboo have to be split to make a hollow pole. *(See page 49-50)*. The bamboo are joined together by fitting a small bamboo into the end of a larger bamboo. Split bamboo can be placed under a water fall to carry water, or pipes of bamboo can be placed in deep pools.

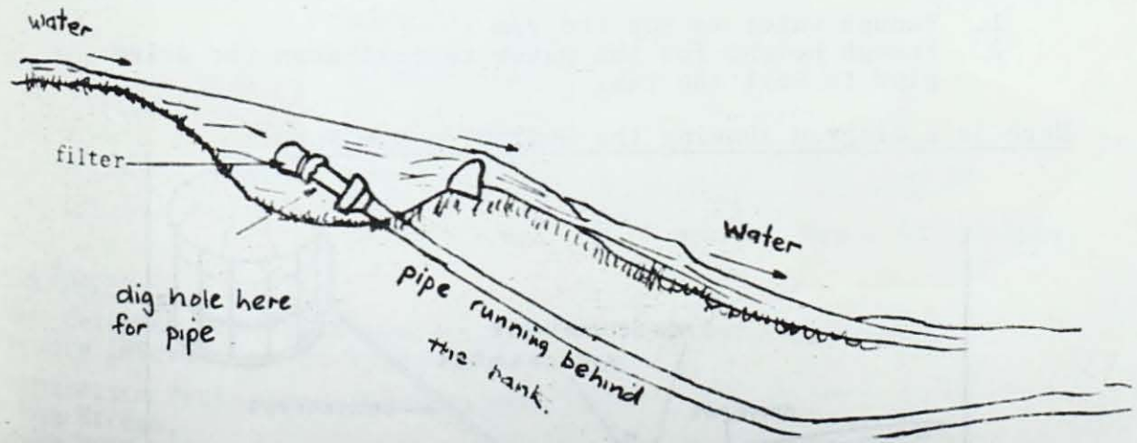
3. The pipe is placed under the water to catch the water and it is then carried downhill. The pipe can be placed directly in the water, or a drain is dug from the bank to the water to put the pipe in at a lower level.

The pipe must be placed in a spot which:
   1. will always be covered with water
   2. is not too close to the bottom to collect dirt and silt.

4. A filter is placed at the head of the pipe to keep out leaves, and dirt. A wire or plastic mesh is tied around the pipe.



i) Pipe placed directly in the water with stones to hold it in place.



ii) If the pool is small, a drain can be dug from the bank to the pool, and the pipe put in that way. The drain can be lined with stones to keep it from getting muddy.

In piping water, care should be taken that:

1. the pipe will not move out of the water
2. the pipe will not break or tear on rocks or stones. Keep a check for holes in the pipe.

Water outlet

Where the pipe ends, a post can be put in with a pipe and tap attached to it, to use the water.

From: Village Technology - Gravity Feed Water System by Neil Anderson, Office of Village Development, Box 6937, Boroko, Papua New Guinea.

(available in pidgin)

2. Pumps

When water is below us or underground, pumps can be used to lift water to where we want it. There are many different kinds of pumps available. The type of pump used and its size will depend on:

1. the flow of the water
2. the distance the water is from the pump.

Some pumps are attached to wells, to draw the water up. Some pumps can be placed on the surface of the water and will draw it up a short distance to the fields (eg. from irrigation drains).

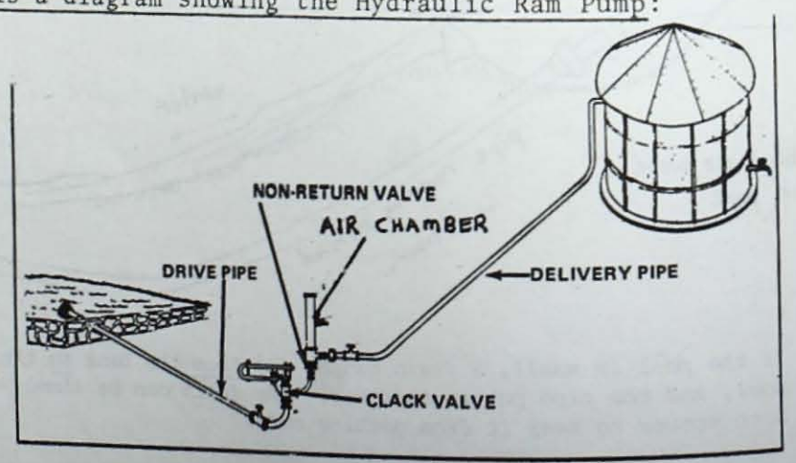
One very simple pump which can be used to push water uphill is the HYDRAULIC RAM PUMP. It can be purchased and is not difficult to install.

The Hydraulic Ram

The hydraulic ram is self-powered pump which uses the power or energy of falling or flowing water to lift some of this water to a level above the source of the water. The pump has only two working parts. Two things are needed to make a hydraulic ram work:

1. Enough water to run the ram
2. Enough height for the water to fall down the drive pipe to work the ram.

Here is a diagram showing the Hydraulic Ram Pump:



How the pump works:

The water starts to run down through the drive pipe, running faster and faster as it goes downhill, until it forces the clack valve to close.

The weight of water stopped suddenly by the closing creates a pressure. This pressure forces water past the non-return valve into the air chamber.

The water pushes down (compresses) the air more and more, until the air acts as a spring and forces the water out again and up the delivery pipe. The water can be stored in a tank (as shown in the picture) or used directly from a tap attached to the pipe.

Adapted from: World Neighbours; Water Pumping Systems using renewable energies, German Appropriate Technology Exchange, 1978.

The pump can be purchased from suppliers. It will cost money but lasts a long time. The hydraulic ram can lift water above the source to distances of 150 feet. Ask at government offices for field workers who can give advice on this method of transporting water.
NOTE: To use a hydraulic pump you need to have FLOWING WATER.

Where to get the pump at low cost:

Village Equipment Suppliers,
P.O. Box 2172,
Lae,
Papua New Guinea.

Enquiries can be made to:

South Pacific Appropriate Technology Foundation,
Box 6937, Boroko,
Papua New Guinea

Plans for making a pump from local materials:

VITA,
College Campus,
Schenectady,
New York 12308
United States.

Also: The Construction of a Hydraulic Ram by A.R. Inversin, SPATF, 1978.
Address: Box 6937, Boroko, Papua New Guinea.

Hand Pumps

Pumps designed for wells can be purchased in hardware shops.
For more information on types of handpumps:

Intermediate Technology Development Group,
9 King Street,
London WC2E 8HN, ENGLAND. or local bodies;
hardware shops.

C. WELLS

When water does not appear on the surface, in springs or streams or rivers, this does not mean that there is no water in the area. Often there is water only a few metres below the ground. By digging wells, we can reach the water table below the ground. This can save a lot of time and work that would be spent trying to carry water from a long way off. Wells are sometimes needed in areas where there are long dry seasons or not much rain.

Wells can be dug to reach the water. Simple pumps can be used to lift the water to the surface. Or, we can do what people have done for years - lower a pot or bucket into the well and draw it up full of water.

There are two types of wells:

i) dug wells
ii) drilled wells

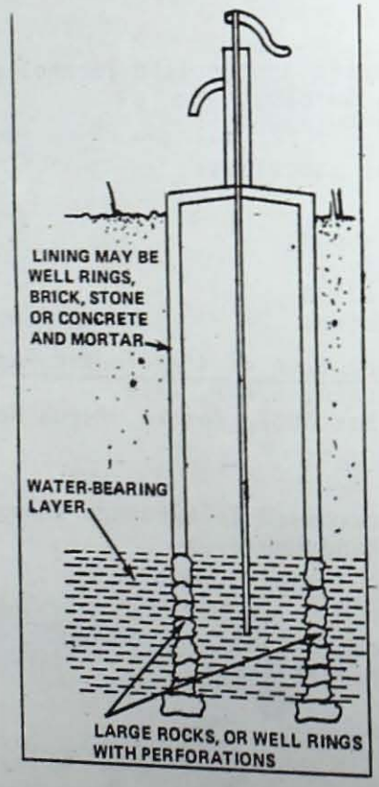
When water is only a few metres below the ground, we can dig a well with a pick and shovel. If the water is very far below the surface, wells usually have to be dug with a drill.

The following shows pictures of a shallow well or a series of wells which can be dug using a pick and shovel.

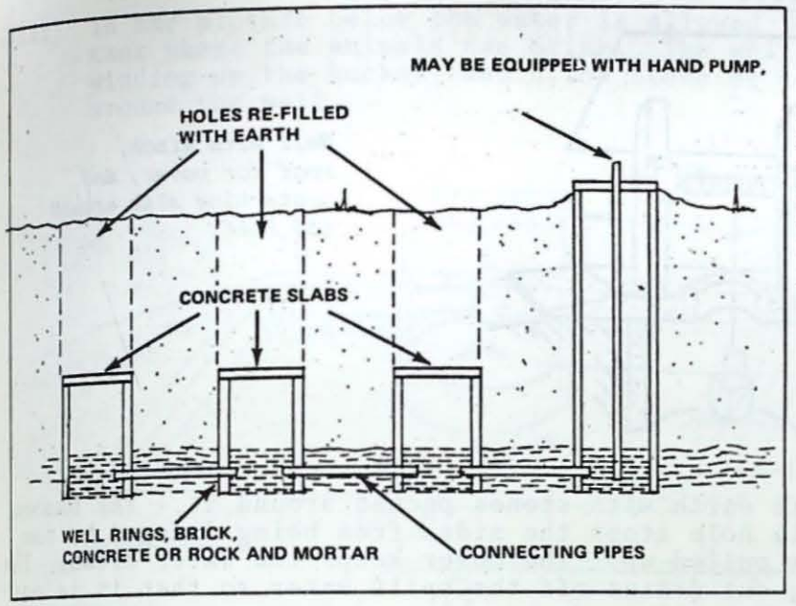
Making a Well

A well isn't just a hole in the ground. The sides of the well must be lined so that they will not fall in. Lining the well also prevents pollutants (unclean or disease carrying materials) from entering the well and spoiling the water. The well must also be made clean and safe above the ground, so that animals or people cannot spoil the water. A well can be built around with concrete or packed with stones to keep it clean.

A pump or winch will make it easier to draw up the water from the well.



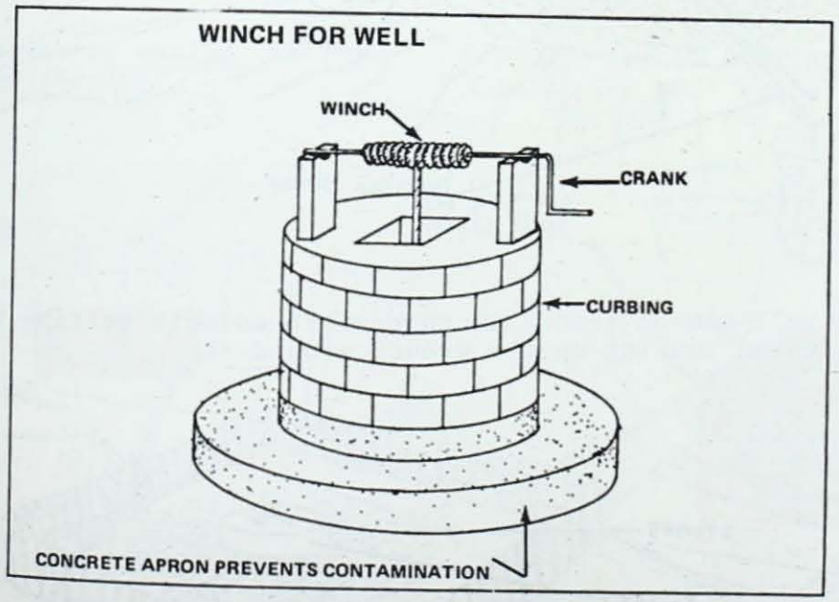
A simple dug well.
Large rocks at the bottom give it a strong base.
The well is lined with concrete or stone.
A pump helps lift the water.



A series of wells with pipes joining them together. This allows for more water to be stored and it takes up less space than one large well.

When larger quantities of water are needed, we can dig a series of wells, with pipes connecting one well to the next. Only one well needs to be left open to draw water. The other wells are filled in again and covered with a concrete slab, leaving enough room for the water to be collected and stored.

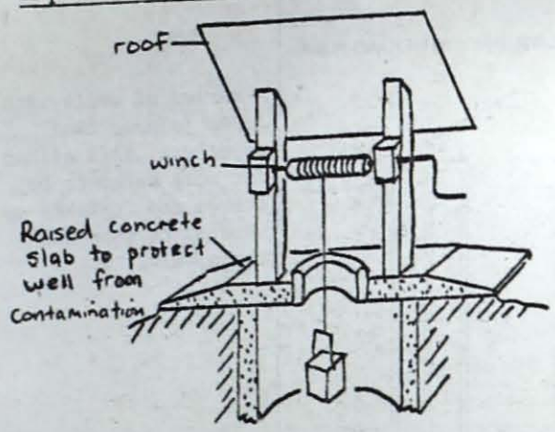
A pump, winch or windmill can be used to lift the water to the surface.



A winch for lifting water.

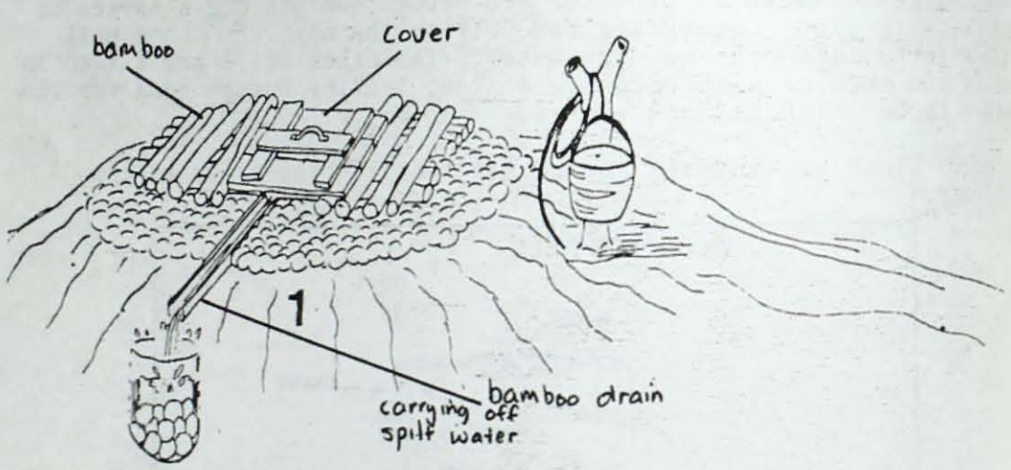
From: World Neighbours newsletter

Improvements to wells

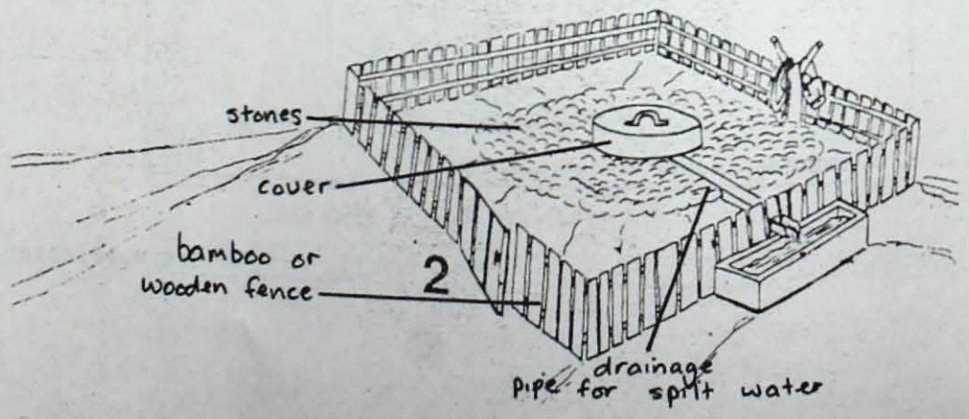


Well with winch, roof for cover, and protecting slab around the hole.

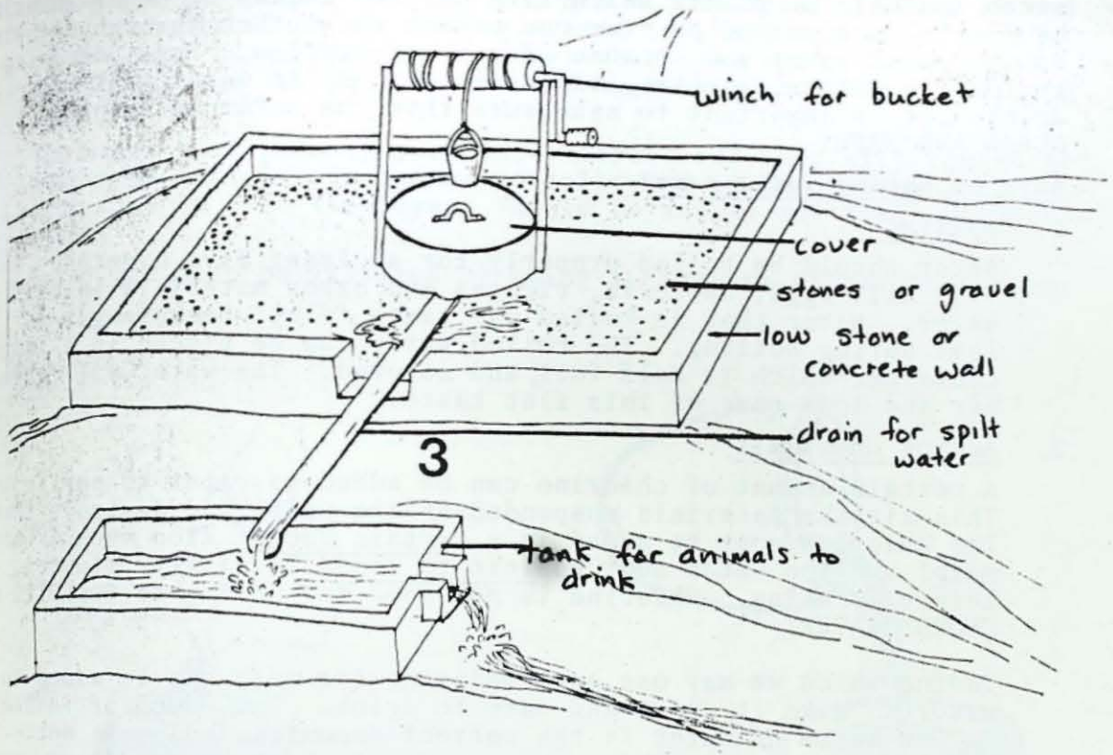
(i) A well in soft earth with stones packed around it. The bamboo round the well hole stops the sides from being damaged by the rope as it is pulled up. The cover keeps the water clean. The pipe sticking out drains off the spilt water so that is is not muddy around the well.



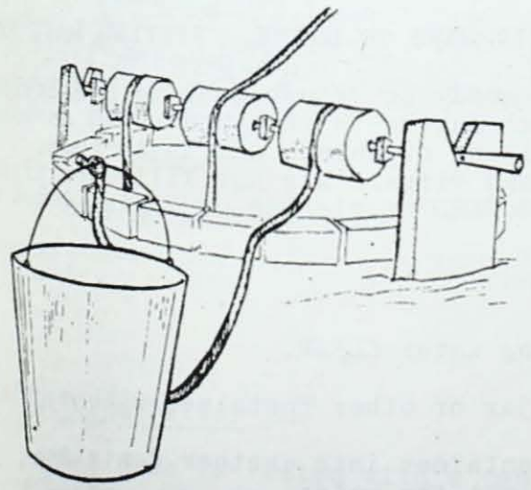
(ii) The well can be fenced in to prevent animals getting too close to it and fouling up the ground around it.



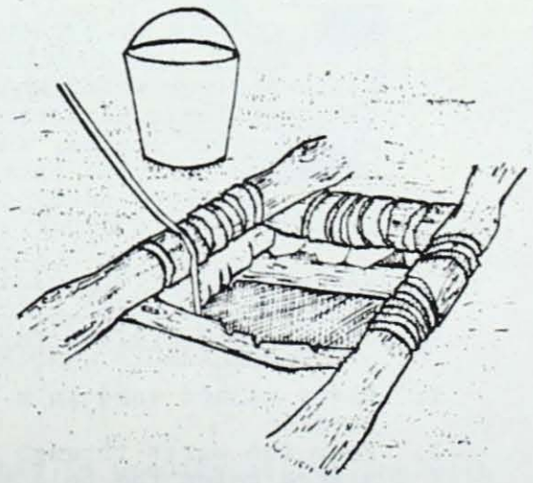
(iii) In the picture below the water is allowed to flow into a small tank where the animals can drink. The well has a winch for winding up the bucket, and a low stone or concrete wall is built around the well.



(iv) One way of saving the rope from fraying:



(v) One way of saving the edges of the well being damaged by the rope:



From: Simple technologies for Rural Women in Bangladesh by Elizabeth O'Kelly, UNICEF, Bangladesh, 1978.

D. PURIFYING WATER

Making clean safe drinking water

Water can carry diseases which are harmful. Even water which looks clear and clean can contain bacteria carrying disease. Many parasites (animals or plants which live off the bodies of other animals or plants) are passed on from one person to another through drinking contaminated water and because of poor sanitation. Eggs, decaying or rotting matter, viruses, can also be found in water that we drink. It is important to make sure that the water we drink is CLEAN AND SAFE.

Ways of making water safe:

1. Boiling

   Water should be boiled properly for at least five minutes. This will kill eggs, bacteria, viruses and other materials in the water. Water that is boiled may taste 'flat' because gas is lost during boiling. The boiled water can be placed in a large container which is half full, and covered. The water will absorb air and lose some of this flat taste.

2. Adding Chemicals

   A certain amount of chlorine can be added to water to purify it. This attacks materials suspended in the water and destroys them. The chlorine must be added in a certain amount (too much is not safe) and the water must be left to stand for thirty minutes before drinking. Chlorine is not good for adding to POLLUTED or CLOUDY WATER.

   Iodine which we may use as a medicine for cuts can be added to water to make it clean and safe to drink. Two drops of iodine to one quart of water is the correct amount. Iodine is not good for cloudy or muddy water or water which has a colour, even if it is clear. The water should be filtered first *(See below)*. Four drops of iodine to one quart can then be added, but it will make the water taste like medicine.

3. Filters

   NOTE: FILTERS DO NOT MAKE WATER SAFE TO DRINK. FILTERS MAKE THE WATER LOOK CLEANER ONLY.
   Filters clear water which is muddy or cloudy looking. Filters take out large particles which may be in the water such as worm eggs, cysts, leaves, small living organisms and their food. Disease - carrying bacteria and viruses are not killed by filtering. The water needs to be BOILED or clorine or iodine added to make it safe to drink.

Filters

Sand is a simple filter for making water CLEAR.

1. Place washed sand in a box, jar or other container with a hole in it.
2. Pour the water through the container into another container placed below the hole to collect the water.
3. Large particles in the water will remain in the sand while cleaner water will collect in the container.
4. A thin layer of bacteria will form at the top if the same sand is used for filtering. This layer of bacteria will help the filtering process.

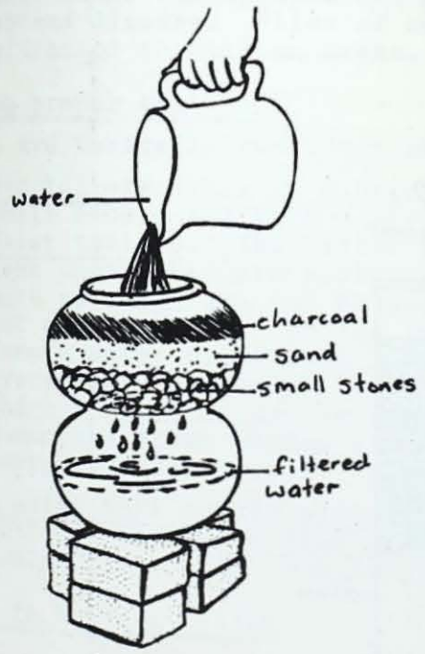
5. After a while the sand should be washed and dried and used again or new lot of sand should be used.

1. Charcoal and Stone Filter

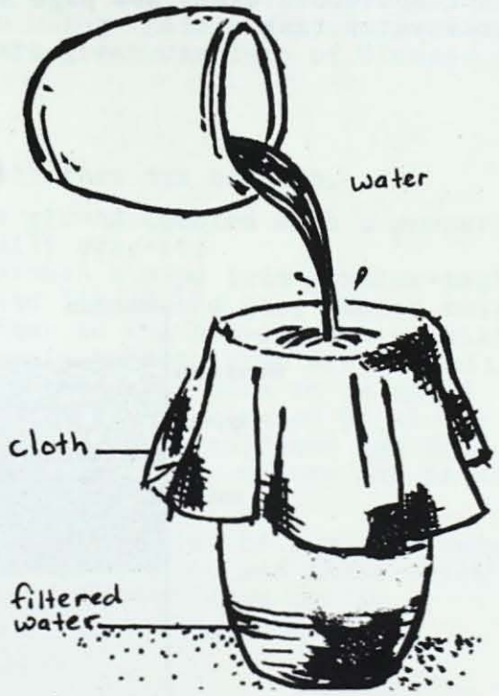
Below are two pots. The top pot has a hole in it. Small stones have been placed in the bottom. Sand is placed on top. On top of the sand is a layer of charcoal which has been crushed into small pieces. The stones and sand must be washed before putting them in the pot.

The water will pass through these layers and they will remove the suspended matter. The water is collected in the bottom pot. From time to time the layers should be washed and then put back again.

Water can also be filtered by using a cloth to filter the water.



Charcoal and stone filter.



Cloth used for filtering.

From: Simple Technologies for Rural Women in Bangladesh by Elizabeth O'Kelly, UNICEF, BANGLADESH, 1978.

2. Oil Drum Filter

An oil drum is fitted with a tap and has an opening at the top with a cover. The drum is filled with layers of filtering material starting with:

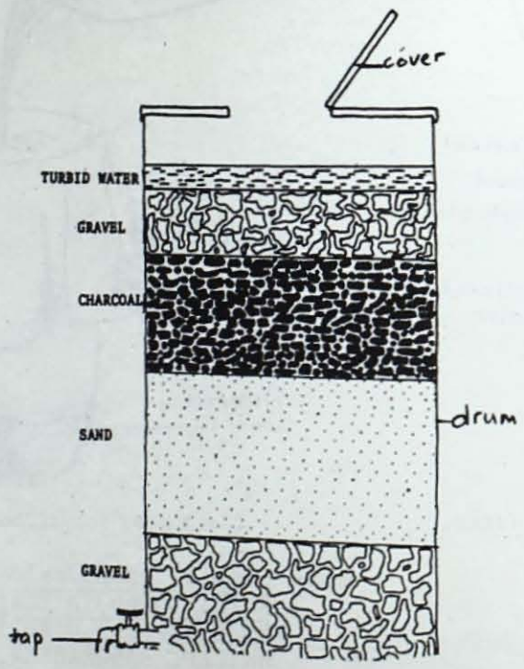
1. Washed gravel. The layer is approximately 25 cms. thick.
2. Coarse, washed sand. The layer is approximately 25 cms. thick.

3. Washed charcoal pieces. The layer is approximately 15 cms. thick.
4. A thin layer of washed gravel is placed on top to keep the charcoal down. This layer is about 5-10 cms. thick.

Water is poured in the top and filtered water drawn through the tap at the bottom. Water can be stored and used as needed. A few drops of chlorine or iodine should be added to the water or it should be boiled, before drinking.

5. The filter can be used for up to 6 weeks before it becomes too full of collected materials.
6. Remove the layers of filtering material - charcoal, gravel and sand. Spread on the ground to dry in the sun. Dust and wash to remove dried film of material collected by the filter.
7. Refill filter.

The drum is particularly good for use in schools, institutions and for household use. See page 58 for a similar filter built above a rainwater tank.



Oil drum filter.

From: An International Water Filter by Prof. N.M. Merchant, as reprinted in Appropriate Technology, Vol 3 No. 3., ITDG, London.

SECTION TWO - SANITATION

Not everyone has a proper water supplied toilet built into their house. Many people have to build their own toilets in their homes or in the village.

Human waste carries disease which can be spread by humans, animals, flies, and through the water and soil. Having good toilets or latrines can help control the spread of disease. Dysentry, cholera, typhoid and worms can be avoided by having good latrines. Good sanitation also means having a good clean water supply, personal cleanliness especially washing hands when eating or preparing food, and a clean living area.

It is no good for just one or two families to have a good toilet. Sanitation involves everybody because people spread disease as well as it being spread by flies, soil, water etc. So good sanitation must cover the whole area where people live and it must involve the whole community. Often the beach or bush is used instead of proper toilets and this means that people and animals using these areas can pick up and spread disease. Flies of course are great carriers of disease and are attracted to unclean areas.

Making proper toilets

There are basically two types of toilets that can be made.

1. Pit toilets. This is a hole in the ground covered with a properly built floor, and with a shelter built over it.
2. Water toilets. The wastes pass through a pipe into a water-tight tank where they are broken down into liquid and gas. Water toilets have no smell and can be built closer to the house. Wastes will not enter the soil or the water supply because they are channelled into a water tight tank. The toilet does not have to be moved every few years only the tank is occasionally cleared of sludge which is left at the bottom. In China, the liquid and gas from human and other wastes are used extensively for manure and as an energy source.

   A water seal toilet slab can cover a pit toilet or a proper water toilet. The water seal slab is a special mould and shape which seals off the pit from the open air and keeps down smells.

Where to build a toilet

Toilets need to be fairly close to the house so that people will use them. But they should not be too close to the house unless it is a proper water toilet. Care must be taken so that seepage from a toilet does not enter the water supply and make it unsafe.

Toilets should not be built up from where water is collected. Water underground can be contaminated if toilets are built too close to the water table. It is always a good idea if possible to get the help of a Health official or extension officer on where to built a toilet.

Put toilets downhill from the water source or far to one side. If the toilet has to be built above the water supply, make sure it is at least 50 feet away, or better still - 100 feet away.

A. BUILDING A TOILET

For pit toilets, the latrine has to be moved every 8-15 years to be built on a new spot. It is better to build a toilet that will last and that can be easily moved. This will save extra work later.

All toilets should have a concrete water seal slab or concrete open hole slab which will cover the whole floor of the toilet. This is easier to keep clean, and will not be spoilt by damp or insects or rats. Toilets should also have openings at the top for air, and shade and a cover over the seat or hole so that it will not attract flies.

The toilet should be built up on a mound for good drainage and so that the ground around the toilet does not become soggy. The mound can be lined with stones if you do not have concrete. Stones leading up to the toilet for people to walk on when the ground is wet will also keep the toilet clean.

A water seal toilet with wooden shelter, door with a latch, roof with space for air to enter, walking stones leading up to door.

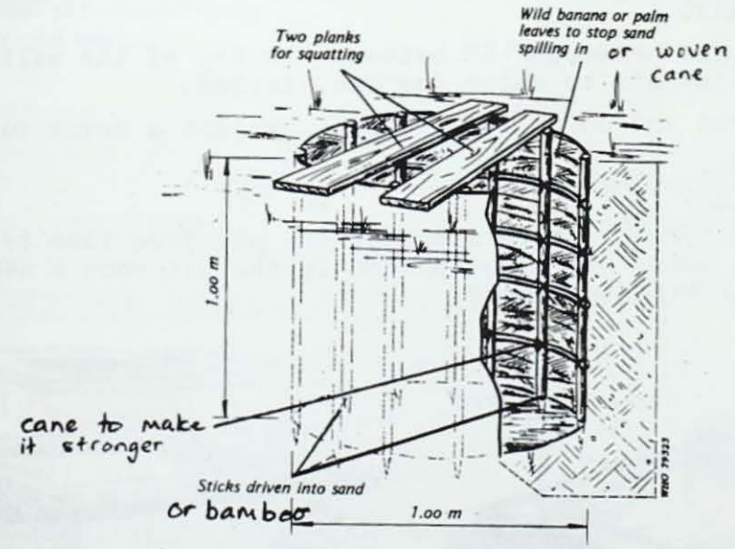
Adapted from: VITA Village Technology Handbook.

1. A Simple Pit Latrines

A very simple pit toilet:

Some kind of toilet is better than no toilet and the danger of spreading disease. This is a pit toilet and is of the very simplest type to build. It will last a reasonable length of time and a woman can build it if there is no help available to build a more lasting toilet.

1. A hole about 1 metre deep and 1 metre wide is dug in the sand or soil.
2. The sides of the hole are lined with wild banana leaves or plaited palm leaves or plaited cane or bamboo. Strong sticks or bamboo are pushed into the sand or soil around the hole, to give it support. Small cane or vines can be tied around the sticks to hold them in place.
3. Two pieces of wood are placed over the hole for squatting.
4. The sand or soil used to dig out the hole is kept at the side of the hole. Each time the toilet is used, a handful of sand is thrown over the pile to keep away flies. THIS IS IMPORTANT. Flies on human wastes can spread disease.
5. The toilet can last from 4-6 months. A woman can build the toilet easily herself.
   At the end of six months, cover the hole and plant a fruit tree on it for the family.
6. Other improvements that can be made - a cover for the toilet of plaited palm leaves or a piece of tin or board.



A very simple pit latrine.

From: Medical Superintendent, Manguzi Mission Hospital, Maputa, Mozambique. Reprinted in Appropriate Technology for Health newsletter, WHO, June, 1979.

2. A Pit Toilet

A proper pit toilet can last between 4-15 years, depending on the number of people using it.

1. The pit is round or square. A 3 foot square pit is a normal size. Or it can be up to 3 feet wide and 10 feet deep. Line the whole pit with concrete, stones or brick, or bamboo posts and woven cane, covered with a layer of cement. This stops the sides from falling in. The top 2 feet at least should be lined with cement to make a solid base and shelter.
2. Make a base for the toilet. The base prevents hookworm from escaping and keeps out surface water, and keeps rats from burrowing into the pit. The base should be at least 4 inches or 6 inches thick. The base is built on a mound of earth which prevents flooding and keeps it dry.

To make the base:

i) Build a wooden frame that is 4' 4" x 4' 4" (with a height of 4-6 inches.) Build a second frame that is 3' x 3' and has the same height. Place the second frame inside the first frame on a piece of board. Pour concrete into the space between the frames. The concrete should be strong, with very little water. Leave it to set for 24 hours.
This is the outside slab or the floor slab.

ii) Build a frame for a second slab. Make the outside frame 3' 8" x 3' 8". Make the inside frame whatever size you would like for the toilet hole. Put the frames together on a wooden form and fill with concrete. Leave for 24 hours. Place the floor slab over the pit, then the second slab on top.

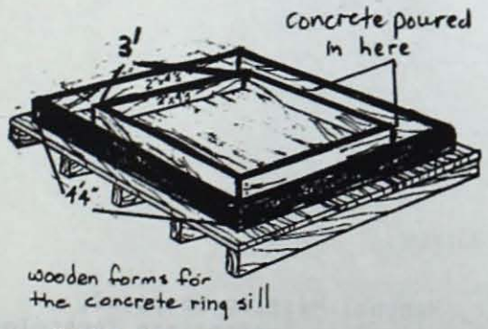
3. To make the shelter: Make a house out of bush materials or timber to fit the floor slab. Do not leave any space between the floor and the wall.

   Leave a space between 4"-6" between the top of the walls and the roof to allow air to enter for ventilation.

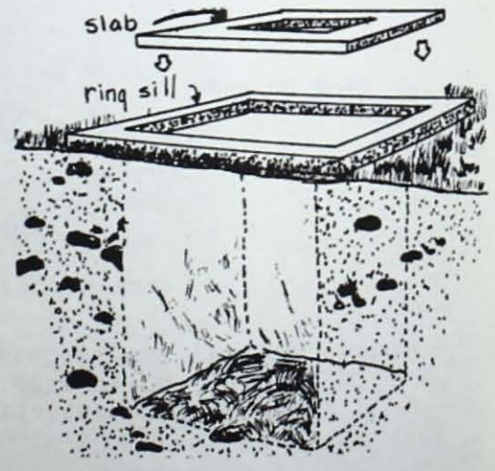
   Build a seat and cover for the pit, or just a cover to keep the flies out.

Using the toilet:

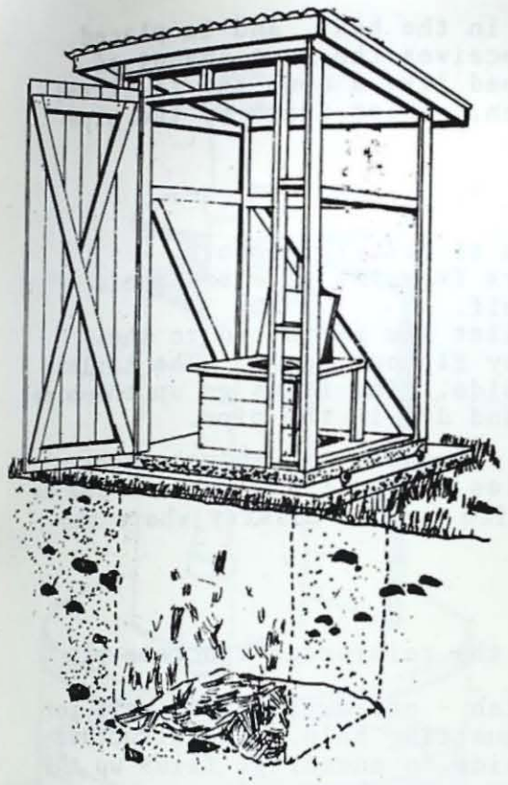
Ashes from the fire or stove added to the pit from time to time will keep the smell down. Kerosene poured in the pit once a week will stop mosquitoes breeding there.



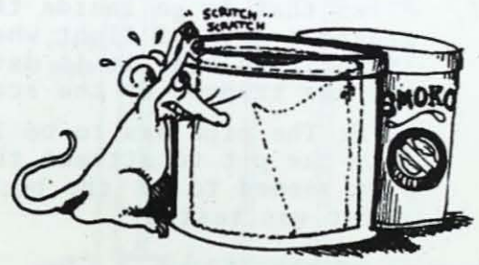
Frames for pouring the concrete.



Placing ring sill or floor slab and top slab.



Completed pit toilet with shelter and seat.



Store toilet paper in tins where rats can't get at them.

Illustrations: Mother Earth News.

Adapted from: Cloudburst, Seattle, Washington, 1973.

VITA Village Technology Handbook.

3. A Ventilated Pit Toilet

This is a deep pit latrine with a simple system for ventilation (letting in air to the toilet which reduces smells). Pit toilets work well except they often have a problem with flies which carry disease. Flies and odors are two problems of pit toilets. This toilet deals with both these problems in a very simple way.

The Blair Ventilated Privy (Toilet)

It uses air to ventilate the toilet properly and an air pipe carries away the smell. It does not need water to operate.

A ventilation (or air) pipe reaches into the pit through the concrete floor slab. The pipe is placed outside the toilet shelter and reaches high above the roof. The pipe on the outside is hot and inside the pipe is cool. The difference of temperature causes air and gases to be drawn up into the pipe, and expelled high up over the roof.

The pipe is painted black which holds in the heat, and is placed outside the toilet shelter where it receives the most amount of sunlight. The top of the pipe is shaped like a cone and is fitted with a copper or fibreglass fly screen. Flies drawn up the pipe are caught in the trap.

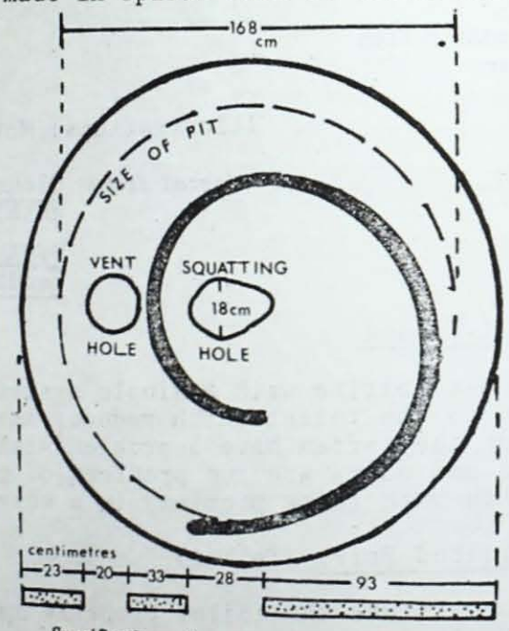
How it works:

1. The pipe draws up air and gases as described above.
2. Flies are attracted to the odors from the pipe and avoid going in the actual toilet itself.
3. Flies that do go inside the toilet are attracted to the greatest area of light when they fly out again. The toilet is built so that it is dark inside. The flies go up the pipe and are trapped by the screen and die in the pipe.

NOTE: The pipe has to be large enough to let enough light into the pit to attract the flies on their way out. A 150 mm pipe seemed to be the best choice in the country where the toilet was tested.

Structure of the toilet

1. A concrete slab is placed over the reinforced concrete pit as for other pit toilets.
2. Two openings are made in the slab - one outside the wall for the pipe, one inside for the squatting hole. The structure of the shelter must be dark inside to encourage flies up the pipe, so it is made in spiral form as shown below.



Specifications of concrete slab.

Spiral structure of the shelter showing placement of vent hole and squatting hole.

The structure can be made from bricks or using corrugated iron plastered with cement or bamboo and woven cane plastered with cement.

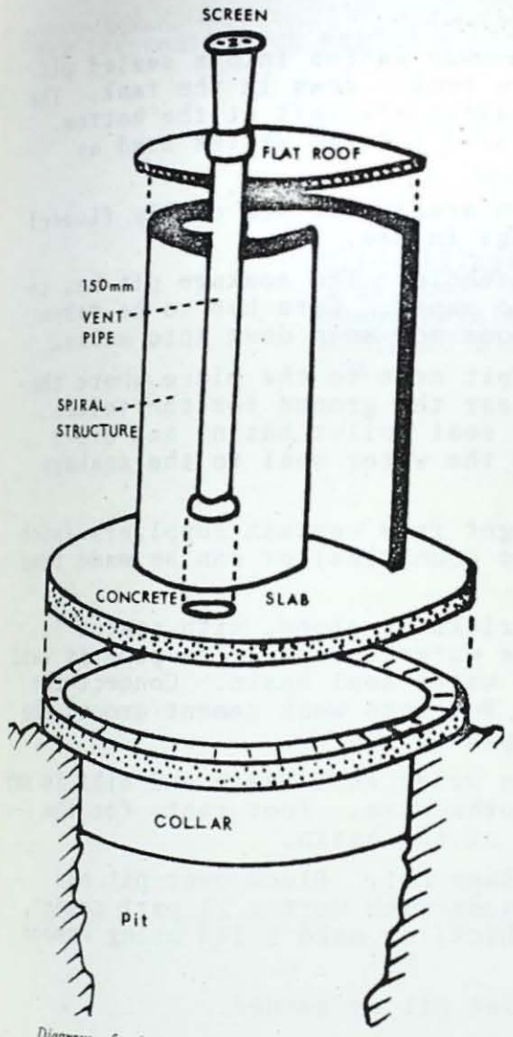
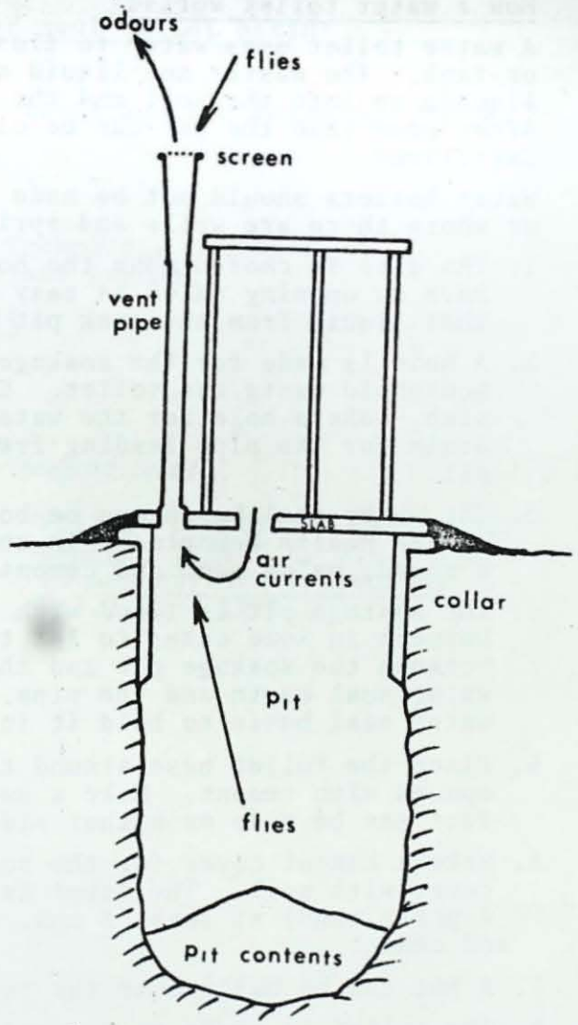


Diagram of privy.



Cross sectional diagram showing air currents and fly movements.

Diagrams of Blair Ventilated Pit Privy.

From: "A Ventilated Pit Privy" by Peter R. Morgan, in Appropriate Technology, Vol. 6 No.3, 1979.

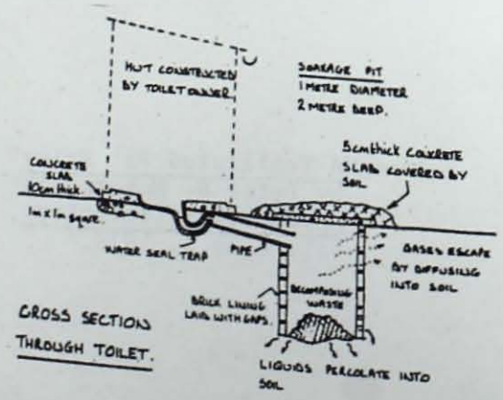
4. Water Toilets

How a water toilet works:

A water toilet uses water to flush away wastes into a sealed pit or tank. The wastes and liquid are broken down in the tank. The liquids go into the soil and the wastes are left at the bottom. After some time the pit can be cleared and the wastes used as fertiliser.

Water toilets should not be made in areas that are easily flooded or where there are wells and springs in use.

1. The site is chosen near the household. The soakage pit has to have an opening which is easy to empty. Care has to be taken that liquid from the soak pit does not seep down into wells.
2. A hole is made for the soakage pit next to the place where the household wants its toilet. Clear the ground for the toilet slab, make a hole for the water seal toilet basin, and dig a drain for the pipe leading from the water seal to the soakage pit.
3. The water seal basin can be bought from certain suppliers (such as the Health Department in some countries) or can be made from a mould, using sand and cement.
4. The soakage pit is lined with bricks or stone, with spaces in between in some cases to let the water escape. The pipe is laid between the soakage pit and the water seal basin. Connect the water seal basin and the pipe. Put some weak cement around the water seal basin to hold it in place.
5. Place the toilet base around the water seal basin and fill in any spaces with cement. Make a smoothe base. Foot rests for the feet can be made on either side of the basin.
6. Make a cement cover for the soakage pit. Place over pit and cover with soil. The cover is made with mortar (1 part cement, 4 parts sand) at least 5 cms. thick, or make a lid using bamboo and cement.
7. A hut can be built over the toilet pit as needed.
8. The toilet is ready to be used. Too much water should not be used to flush down waste or the pit will become flooded. When the pit is full, leave it for 1-2 months to kill bacteria, then empty. The waste remains can be used as a fertiliser. The toilet needs careful use and regular cleaning to work well.



A cross section of a water toilet showing toilet area, drainage pipe, and soakage tank.

For information on making a water seal toilet basin:

SPC Community Education and Training Centre,
Box 5082,
Raiwaqa, SUVA
Fiji.

VITA Village Technology Handbook,
3706 Rhode Island Avenue,
Mount Rainier,
MARYLAND 20822
USA.

Adapted from:

"Village Sanitation Improvement Scheme, India" by S.B. Watt, in Appropriate Technology Vol.2 No.4 1976.

FURNITURE MAKING

"We thought it would be hard but its not."

How do you feel when the work is finished?

"We feel proud"

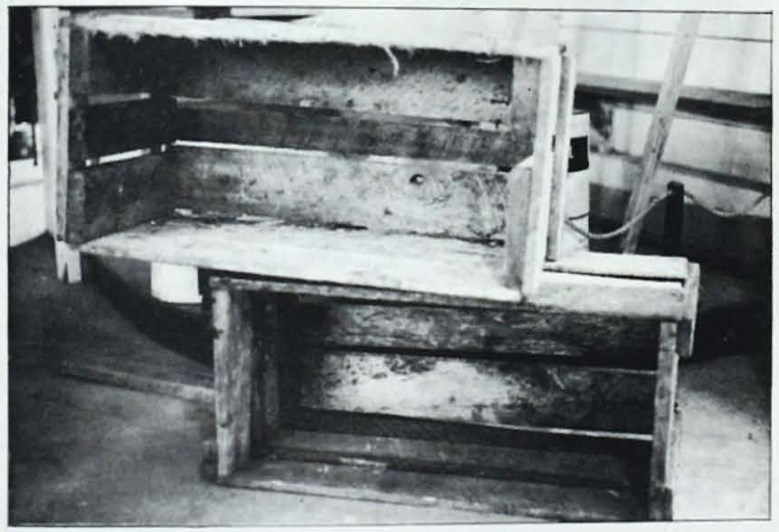
HOUSEHOLD IMPROVEMENTS

HOUSEHOLD IMPROVEMENTS

Many things can be made for the house using scrap materials that are left unused. Simple cleaning items including soap can also be made at home and may save buying these things in the shop.

This chapter covers simple furniture making for the home using packing cases and boxes, and how to make soap and other items which might be useful. In many countries in the Pacific, furniture is not needed as people traditionally uses mats and sit on the floor. However, if some of these items are wanted, these are simple methods of making furniture which may be useful for storage. These are presented here mainly as a cost-saving help, for women in urban areas who may spend family income on furniture which is costly.

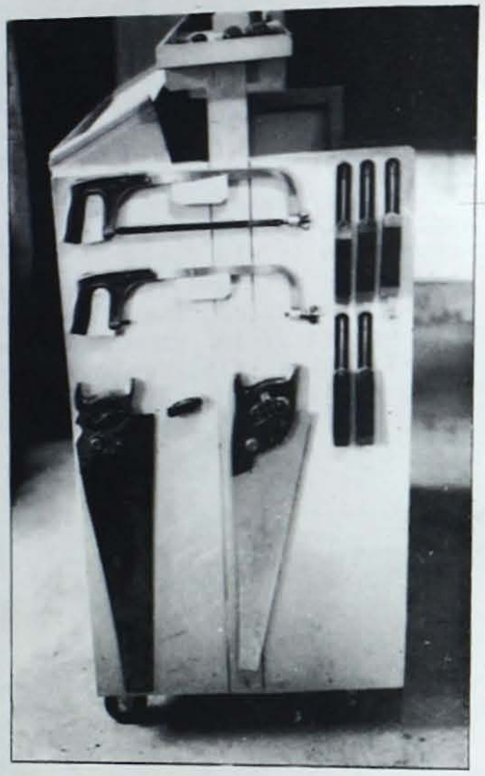
Making your own furniture



Simple packing cases like these can easily be used to make your own furniture.

The following section on furniture is based on instructions for furniture making produced by the SPC Community Education and Training Centre in Nabua, Suva, Fiji. As part of their community education training course, women are taught how to use tools and make furniture using old packing cases and wooden boxes and reeds from the bush. The following pictures show women at the course making furniture. Working together in small groups, the women made a food safe with fly proof door, a food storage cupboard with wire mesh, a wardrobe with mirror, a packing case settee, and a low table or couch covered with reeds.

The women are first taught how to use different tools and materials and how to finish their work. Then with instructions, they left to work in groups to make the furniture items shown.



Women can and should be taught how to use tools - at schools, workshops, in the village.

Women at SPC workshop using saws to cut timber.

A. FURNITURE

1. Food Storage Safes

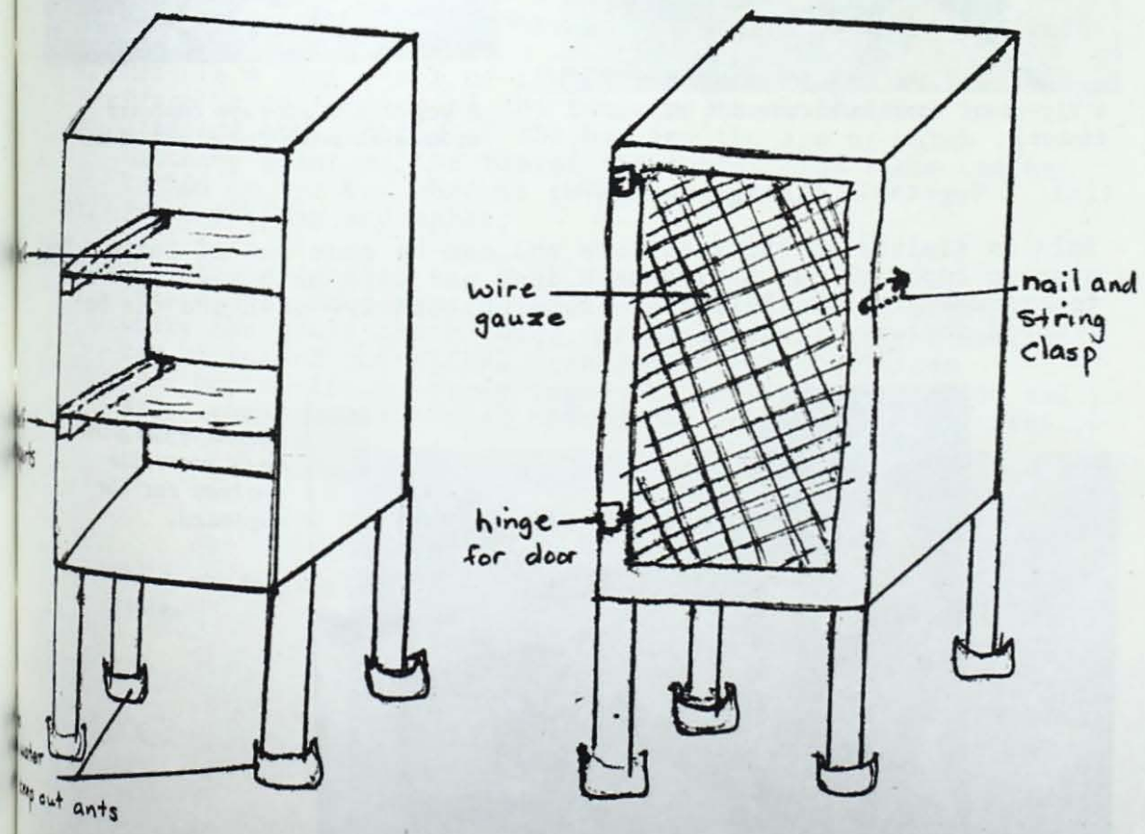
(a) Food Safe with Fly-Proof Door:

Materials:

1 large or two small packing cases
4 pieces of timber for legs
4 small pieces of timber for shelf supports
reeds or masonite board for shelves
wire gauze
nails
sandpaper

How to make:

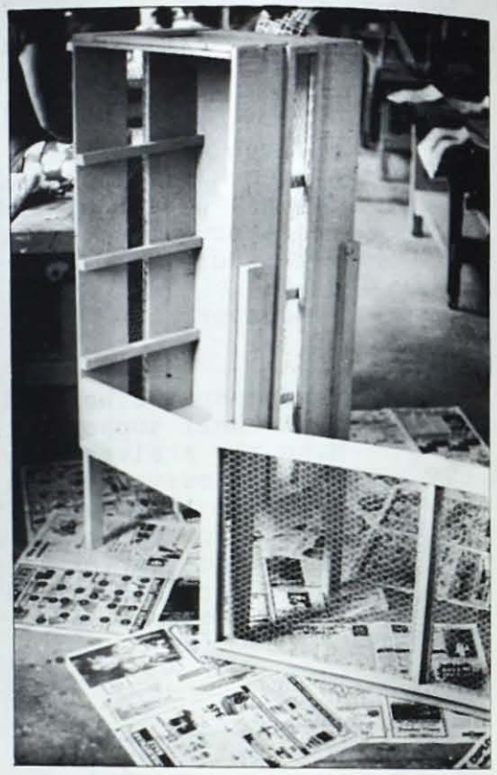
1. Sandpaper the box and 4 leg pieces and shelf supports.
2. Nail shelf supports to the box. Cut shelves to fit on top. Make the shelves removable - do not nail them down. Then the safe is easy to clean.
3. Nail the legs to the box.
4. Make a frame for the door. Cover the door with the wire. Put wooden strips behind the door also. Hinge door to box.
5. Use a firm string and nail to fasten the door.
6. Paint the food safe.



A fly-proof food safe.

Note: Any local timber can be used and bamboo , reeds, etc

A fly-proof food safe made out of timber.



A vegetable storage cupboard with wire mesh front and sides.

(ii) A Vegetable Storage Cupboard:

This is similar to the food safe and can be made out of boxes. The storage cupboard has a wire mesh door and wire mesh sides for air to circulate. The shelves are made out of wire mesh and can be removed for easy cleaning.

Painting the wire mesh removable shelves for the cupboard.

Shelf and Folding Table

Materials:

1 wooden box of convenient size or 2 small packing cases
5 long pieces of timber or bamboo for legs
scraps of wood
1 pair of hinges
nails, hook and eye, sandpaper

Tools: hammer, plane, screw driver

How to make:

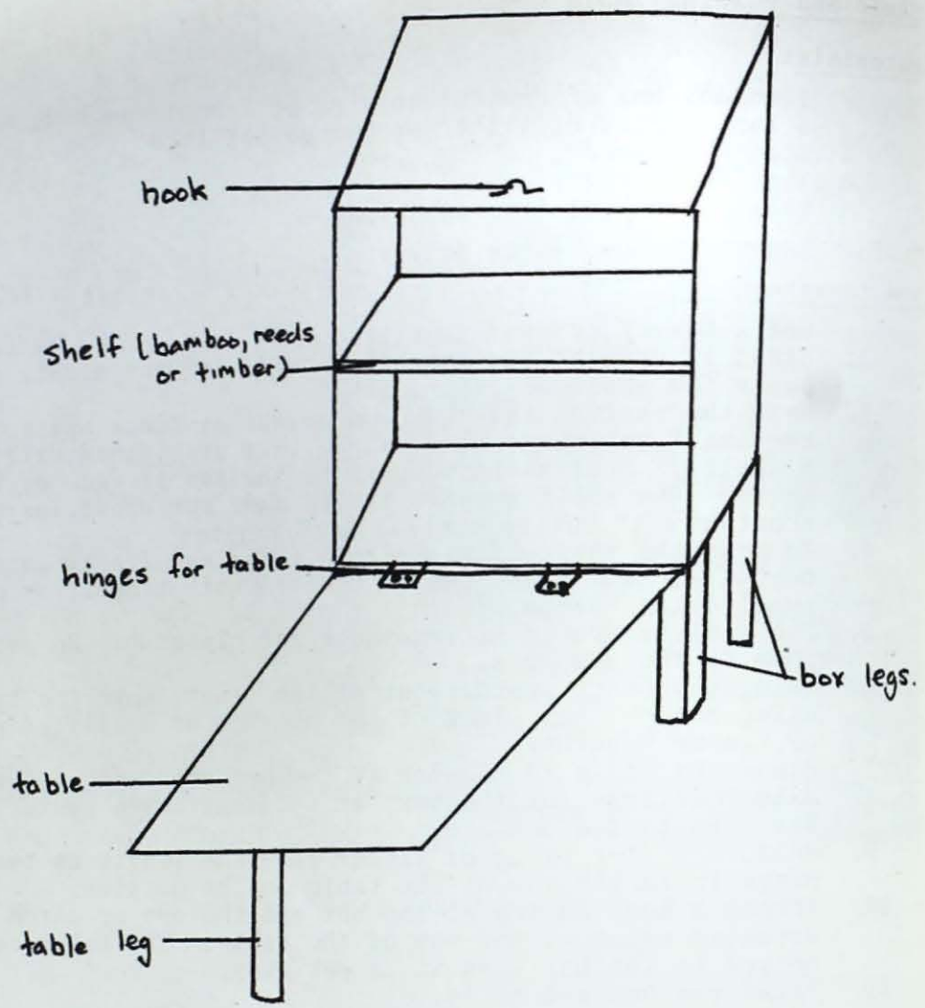
1. Get a box of convenient size.
2. Stand it upright and remove one side for the front. Sandpaper the whole box thoroughly.
3. Mark the shelves inside a convenient distance apart. (If two small boxes are used, where they are joined will form a shelf.) Nail shelf support to the box at each of these marks. The shelf support can be made out of strips of wood about ½" x ½" cut to the required length.
4. To make the shelf, first make a frame and fit it into the cupboard. The frame can be covered with timber, or cane or small split bamboo.
5. The shelves should be removable for cleaning. Do not nail them to the supports.
6. Using the exact measurement of the front, make the table using the cut out piece of the big box or nail flat pieces of timber together.
7. Hinge the table to the box at the bottom.
8. Make four legs for the box, at the length you want. Attach the legs to the box.
9. Measure a flat piece of timber the same length as the 4 legs. Hinge it to the top of the table on the outside.
10. Attach a hook on top of the box and the eye or catch to the matching point at the top of the table. The table can be hooked to the box when it is put away.
11. Paint the box and table.

Use:

1. This can be used as a cupboard to store food or utensils while the table can be used for eating. After the meal it can be folded and allows space for other activities.
2. As a bookshelf and study table for children to work on and to store their books. When closed the table (or desk) takes up little space.

Shelf and folding table.

Diagram of shelf and folding table.



3. A packing case lounge settee

Materials:

1 large packing case (any size available)
scrap materials of wood for legs, arm rests, etc.
sandpaper
nails- 2" wire nails

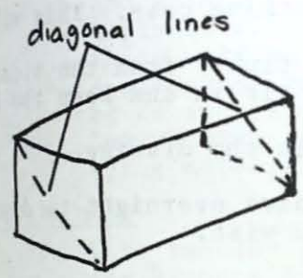
Tools: claw hammer, cross-cut saw, try square, ruler, pencil, plane

How to make:

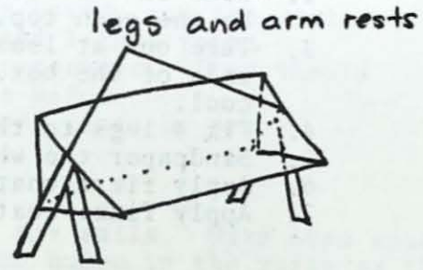
1. Select a suitable box - the size of the settee will be from whatever size box is available.
2. Mark diagonal lines at the ends of the box, then cut, using the cross-saw. *(as shown next page).*
3. Use pieces of flat timber to make legs and arm rests at each end.
4. Fix two braces - one at the back legs and the other at the front legs, to make the legs stronger.
   - two other rails should be fixed at the sides. *(see next page)*
5. Adjust legs if necessary.
6. Sandpaper the box and legs
7. Apply first coat of paint and leave to dry.

8. Apply final coat of paint if you wish.

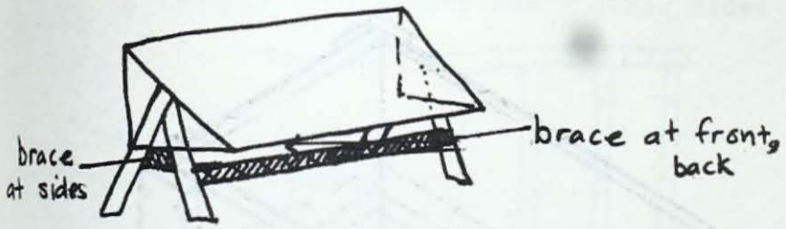
Step 2 - Mark diagonal lines and cut.



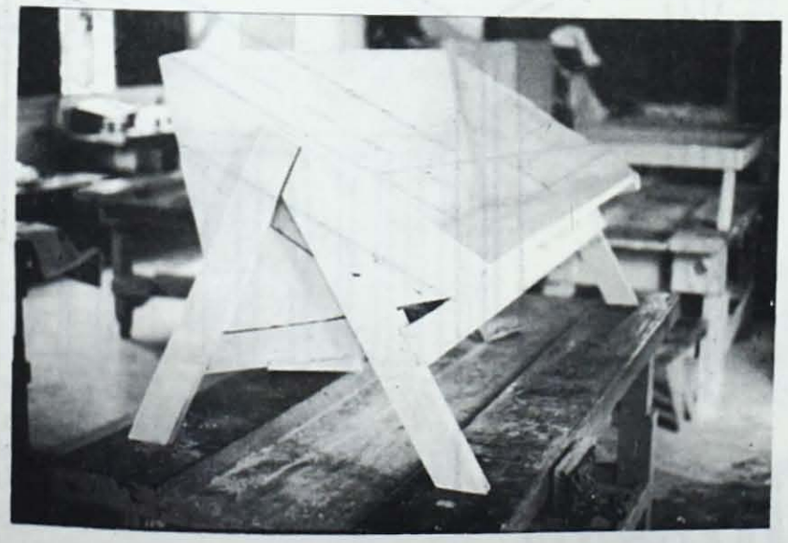
Step 3 - make legs and arm rests.



Step 4 - brace at back and sides



Completed packing case lounge settee



4. A packing case baby's crib

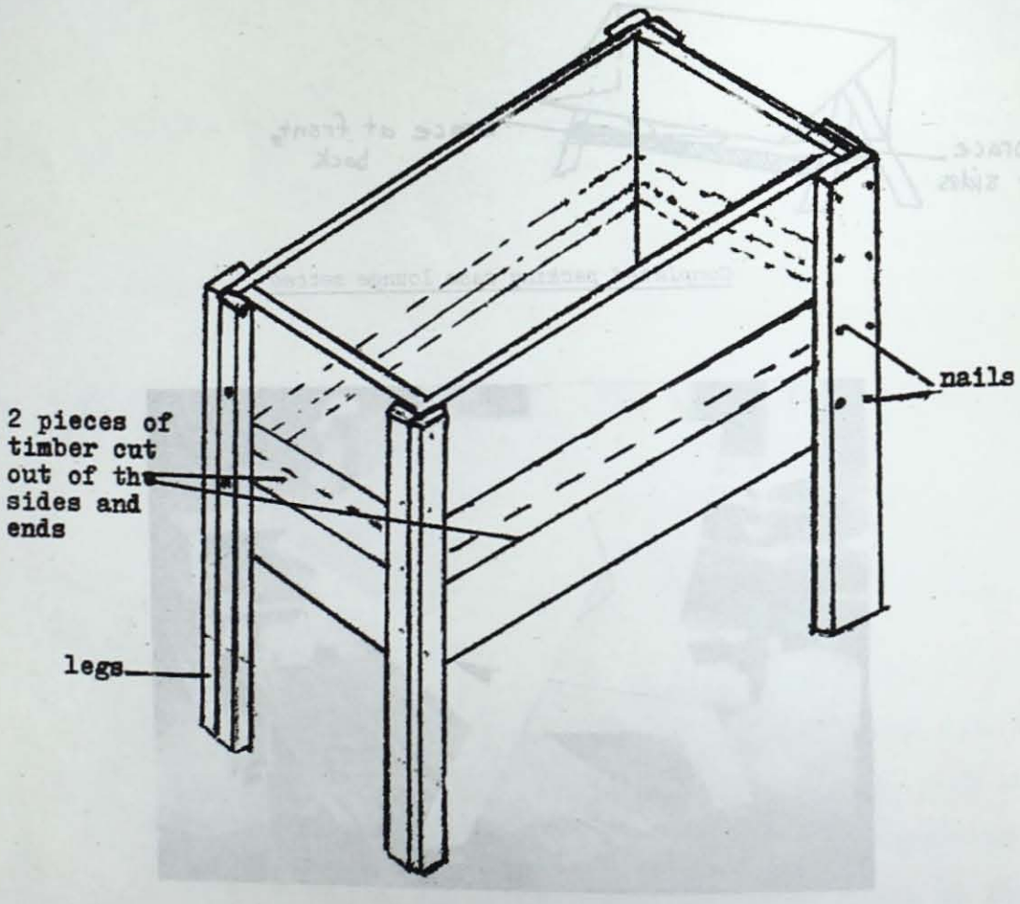
Materials:

1 suitable size packing case
scrap pieces of timber for legs etc.
sandpaper
nails - 2" wire nails

How to make:

1. Get a suitable size packing case.
2. Take out one long side of the packing case. This will be the open top.
3. Take out at least two pieces of timber from the sides and ends of the box. This will let air in and keep the baby cool.
4. Fix 4 legs to the box as shown in the drawing.
5. Sandpaper the whole box.
6. Apply first coat of paint and leave overnight to dry.
7. Apply final coat of paint if you wish.

Completed baby's crib



5. Bamboo play pen

In many countries families build play pens of bamboo or wood for their children. Babies can be kept clean and safe and away from animals such as dogs and chickens. The pen can be moved to different parts of the house or yard while the mother does her work.

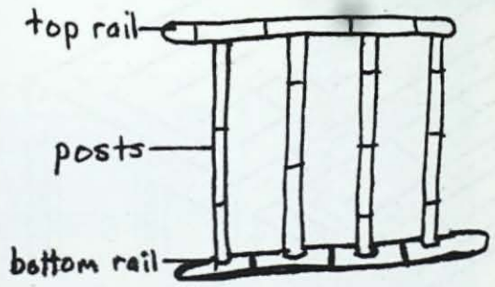
How to make a play pen:

Materials:

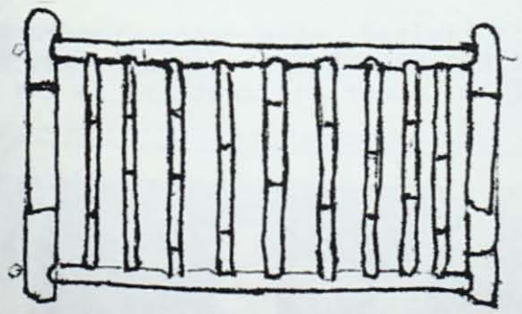
- 36 pieces of small bamboo or wood for upright posts for sides of the pen. They should be 20 inches long and ½ inch round.
- 8 pieces of bamboo or wood for bottom and top rails which will be 40 inches long and 1 inch round.
- 4 pieces of bamboo or wood for corners. They should be 26 inches long and 4 inches wide.
- heavy twine, coconut fibre rope, vines or other tying material.

How to make:

1. Take two 40" pieces of bamboo for rails. Make even spaces for 9 posts in each rail. Make holes in the rails so the posts will fit preperly and not be loose.
2. Put the posts in the holes in the bottom rail. Put on the top rail, joining it to all the posts. This forms one side of the play pen. Make the 3 other sides the same way.



3. Corner posts: Make holes on each side of corner posts for the top and bottom rails. Join a side of the play pen to two corner posts. Fit the top and bottom rails into the the holes in the corner posts. Tie them together with string, rope or vine.



4. Tie the 4 sides of the play pen together so that it will look like this:

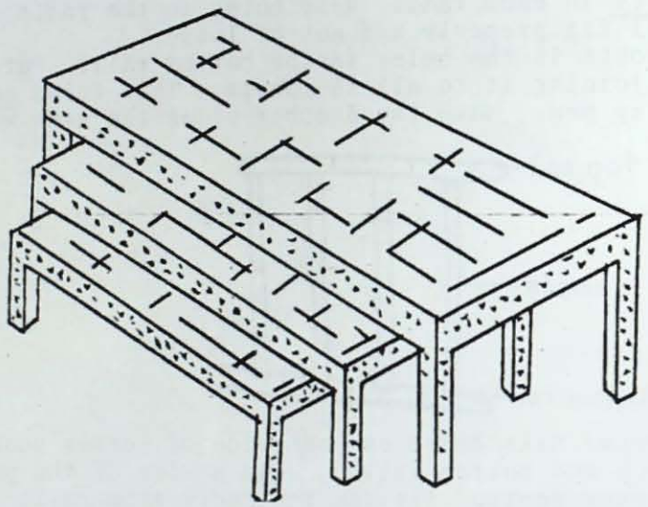
You can make a wood floor or use a mat to keep the baby off the ground. The floor of the pen should be washable. Keep it clean.

Preceding section on furniture adapted from:

South Pacific Commission Community Education and Training Centre, Notes,
Nabua, SUVA
Fiji.

Drawings: South Pacific Commission.

SAVING SPACE IN THE HOUSE:



If the space in the house is limited, make each wooden bed or cot a little shorter and a little lower than the other ones, then in the daytime, they can be placed under one another, as the picture shows.

From: Simple Technologies for Rural Women in Bangladesh by Elizabeth O'Kelly.

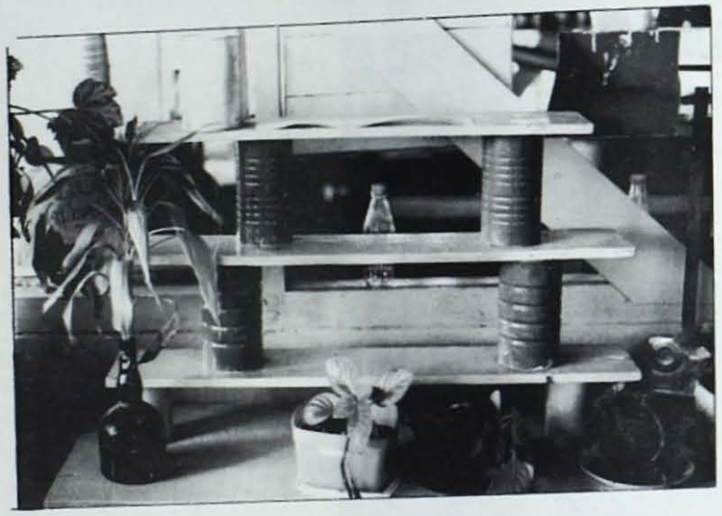
OTHER IDEAS FOR THE HOUSE

A low table or bench.

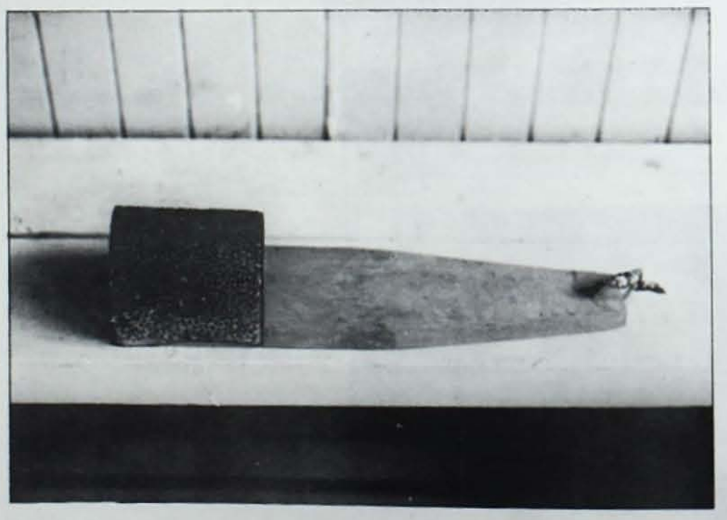
A small stool or table.

Shelves made out of cane and timber.

Cane couch. Cane covers seat and back.



Shelves or bookcase, using old tins (painted) and boards for shelves.



Tin scraper - tin punched with holesand nailed to a piece of wood.

Photos: Vanessa Griffen

B. HOUSEHOLD CLEANERS

1. Making your Own Soap

Soap is made from fats and lye. When soap is mixed with water it froths and forms a lather. This lather washes out dirt.

You can make soap at home, for your own use. It is a good way of using fats and oils which you might otherwise throw away. Soap is good to make at home if this is cheaper than buying it in a shop. If good cheap soap is sold, it may be cheaper to buy it. But if you want to make your own soap or are in a place which does not have soap, here is how you make it:

You will need:

i) FAT OR OIL - either animal or vegetable. Eg. coconut oil, peanut oil, pig fat. Do not use mineral oil - ie. oil used for cars, petroleum oil)
BEEF FAT AND VEGETABLE OIL together make the best soap. Cooking fat or old rancid (bad) fat can be used, but first it must be WASHED by boiling in a lot of water. Skim off the fat or oil and BOIL AGAIN in fresh water. This will remove salt and the materials which are giving the oil a bad smell.

ii) LYE - This can be bought as CAUSTIC SODA. When it is dissolved in water it is called LYE. You can make your own lye from wood or plant ashes. *(See below.)*

LYE BURNS - If it splashes on the skin, wash with water at once and wash with vinegar or lemon or orange juice. If swallowed, give the person as much lemon, orange juice or vinegar as they will take. See a doctor.

iii) WATER - Rainwater is best.

TO MAKE SOAP:

Step 1

We will start from the beginning, as if none of the above materials are available.

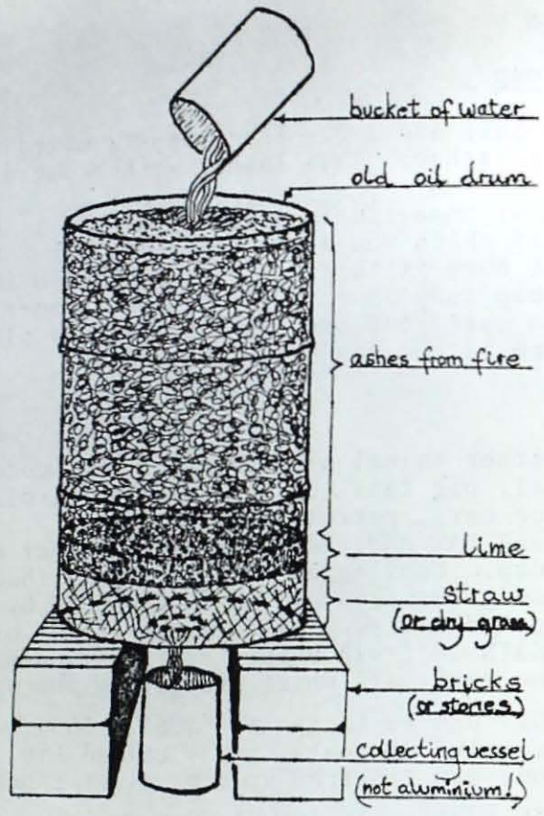
1. How to make oil from coconut. *(See page 99 on how to make this.)*
2. How to make lye from wood ashes. *(See below.)*

If you have oil and lye, move on to Step 3 - how to make soap.

Step 2

LYE FROM WOOD ASHES

1. Take a 44 gallon drum or a barrel. Make a large hole in the bottom. Put it on a board standing on stones or bricks. Leave a space between the stones so that the lye can be collected as it is leached through the hole. Place any container - BUT NOT ALUMINIUM - under the hole to collect the lye.
2. Cover the bottom of the barrel with dry grass or straw. Sprinkle about 2 quarts of dry lime over this. (LIME can be made by burning coral and grinding it to a white powder.) Fill the barrel with ASHES.



Making lye from wood ashes.

THE PRODUCTION OF LYE
FROM WOOD ASHES.

3. Slowly, add one bucket of cold water. Continue to add water every 3-4 hours on the 1st. day, 3rd. day and 5th. day. The lye will drip through into the container underneath. When the lye is strong enough, it can be used to make soap.

TO TEST THE LYE:

Use a wooden spoon, not aluminium, to put a fresh egg or uncooked raw potatoe into the lye. (Be very careful. The lye can burn your hands.) If the egg or potatoe floats, the lye is ready to be used. If not, wait a bit longer, adding more water to the ashes.

Step 3

HOW TO MAKE SOAP

You will need:

lye - 1 can (7 oz. or $\frac{2}{3}$ cups)
fat or oil - 13 cups
cold water - 5 cups
(To make 9 lbs. of soap)

1. Place water in a container of glass or enamel, iron or stainless steel but NOT ALUMINIUM. Pour the lye into the water very carefully, stirring at the same time. The water will bubble.

Do not splash yourself with lye and water because this BURNS. Stir until the lye and water are well mixed. Leave to cool so that you are able to touch the container with your hand.

2. Melt the fat or oil to a clear liquid in a container you will make the soap in - not an aluminium one. Let the fat cool until it begins to feel stiff if your stir it.

3. Pour the lye solution into the fat in a thin steady stream. Stir slowly and evenly at the same time. In about 10-20 mins. the mixture will become thick as the lye is mixed into the fat. Keep aside to thicken and stir occasionally.

4. Pour the thickened soap into containers - these can be strong cardboard boxes lined with damp newspaper or cloth, or wax paper. Let the lining lap over the edges of the containers to help you remove the soap later.

Leave for 1-2 days, then lift from the container. If the container is lined, this will be easier. Cut the soap into pieces and leave in a place where the air can reach it but it is not too windy or cold. The soap will be ready for use in 10-14 days.

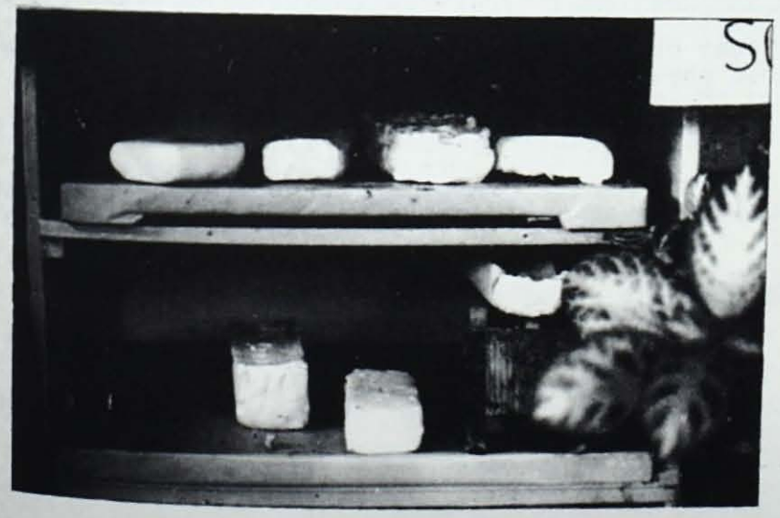
This is good washing soap.

TO MAKE NICE BATH SOAP

Do the same as steps 1-3 above. Then leave overnight in the container. Next day, cut up the soap and peel it into shavings or small thin pieces. Add 7 pints of water. Melt over a low heat and stir. When the soap is melted, increase the fire and continue to boil until it looks like syrup when poured from a spoon.

Cook a little. Add dyes if you like for colour and perfume (if the perfume is in oil only). Pour soap into moulds or shape into balls and hang. Leave to air.

THE OLDER THE SOAP, THE BETTER IT LATHERS.



Soap made by women at the South Pacific Commission Training Centre, Suva.

2. To make Jelly Soap

Add water to the containers used for making the soap, and put the cloth used for lining into the container. Boil slowly, scraping off soap from the sides of the pot and from the spoon used for stirring. Pour liquid from the pot into a container with a wide top and cover tightly. This jelly soap can be used for general cleaning.

Adapted from: "How to make Soap" by Dr. Pauulu Kamarakafego, in Yumi Kirapim, No.6 June, 1978.

"Make your own soap" - South Pacific Commission Education and Training Centre leaflet.

3. Other Cleaners

1. Wood Ash: Get some dry ash from the fire. Sift it or shake it up and down to get the fine pieces. Put the ash in a tin. When cleaning zinc or galvanised iron - for instance, cleaning pots or buckets, use the dry ash wrapped up in pawpaw leaves for scrubbing.

2. Sand: Sift or shake some sand to remove stones and bits of shell. Put the sand in a jar. Use the sand wrapped in pawpaw leaves for cleaning iron, steel, tin, cement floors, stone and hard wood. It is also good for cleaning galvanised buckets and getting dirt out of bottles and jars.

3. Ground Eggshell: Collect eggshells and dry them in the sun or in the oven. Grind or pound the shells into powder. Sift and store in a jar. Use for cleaning tin, enamel pots and plates, aluminium.

4. Stove Mixture: Get some ground charcoal or crush big pieces of charcoal into dust or powder. Mix oil with the charcoal until it is creamy or a smooth paste. Keep it in a tin and use to clean iron pots, and iron stoves.

Adapted from: SPC Community Education and Training Centre Notes.

C. ESSENTIAL ITEMS

1. How to make Cooking Oil from Coconut

You will need:

a grater
cooking pot
stirring stick or spoon
strainer
storage vessels - bottles, jars, clean tins with lids

1. Grate a number of coconuts to fill a fairly large pot.
2. Squeeze as much milk as possible out of the coconut.
3. Heat the milk over a low fire, stirring all the time. The milk will go from white to light brown first. When the oil changes colour from light brown to brown TAKE IT OFF THE FIRE.
4. Cool the oil, strain it. Squeeze out the residue left in the strainer. The oil should be clear and golden. The oil can be used for cooking, as a fuel for kerosene lamps, and for making soap.

NOTE: People make oil all the time from coconuts. The same method is used here ONLY THE OIL IS COOKED LONGER, up to a point when it turns brown. This makes it better for cooking and for use in lamps.

From: "How to make soap" by Dr Pauulu Kamarakafego, as printed in Yumi Kirapim, No.6, 1978.

2. How to make Salt

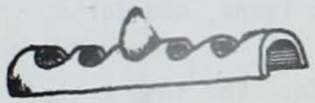
1. Use clean ocean water. Do not use water taken from where a river meets the ocean - the water will not be salty enough.
2. Cut bamboo in two, keeping in the growth rings.
3. Pour salt water into the bamboo and let it dry in the sun. This takes some time. Bamboo placed in a hole or trench dug to 1 foot deep, will stop wind blowing on the water.
4. Salt will collect around the sides and at the bottom of the split bamboo.
5. Collect and store in a container or tin. Store in a dry place.

NOTE: Salt can also be made in the solar drier. *(See page 108)*

D. THINGS TO MAKE

Make a food cover to keep flies away by attaching pieces of fly-wire or coconut matting to a bush cane frame.

Save soap by drilling drain holes in the bottom of half a coconut shell, hang this soap drainer by your sink.



A simple egg rack can be made by burning or cutting holes in a split length of bamboo.

This fish scaler is easily made by nailing bottle tops to a wooden handle.

Reduce insect pests in your garden by smearing a jar with honey or syrup, punching a hole in the lid and leaving next to affected plants

If you have plants in your school or office, the weekend or holiday without water can kill them. Make 'wicks' from thin strips of cloth, wrap around the base of plant stems & dip the other ends into a jar of water. Water will travel along the strips and keep plants moist.

WORKSHOP STORAGE JARS:

Nail or screw the lids from glass jars to the underside of a shelf, and you have a neat way of storing your nails, screws and other small oddments.

I. TRAPS TO CONTROL FLIES

Flies can spread disease and are a nuisance. They need to be controlled inside the house as well as outside, to prevent germs being spread to food etc. Food should be covered or kept in a fly-proof cupboard.

How the traps work:

Here are traps to build which will control flies. They work from the fact that flies fly upwards after feeding. The fly goes towards the bait in the trap, eats, and then flies upwards. It flies through a narrow entrance and cannot find a way out again. The flies trapped already also attract other flies to the bait.

They are made using wire or plastic mesh.

1. The all-screen trap - a screen cylinder and a screen cone are made. The screen cylinder fits over the cone. The lid of the trap should come off easily, to remove the dead flies. The trap is easy to build but the wire mesh is expensive.
2. The wooden frame trap - is much stronger and uses less screen. The screen is fitted over the sides of a wooden box. An A-frame screen cone is made and the box fits over this.

Short legs are made for both traps so that they are only 1-2 inches above the ground. This is important to make the trap work.

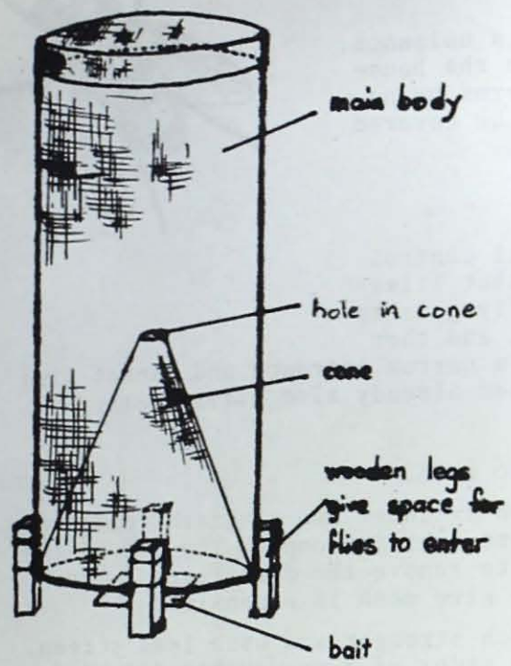
The sizes between the two sections have to be roughly as they are seen in the pictures on the next page. Use local materials or scrap materials where possible.

Using the traps

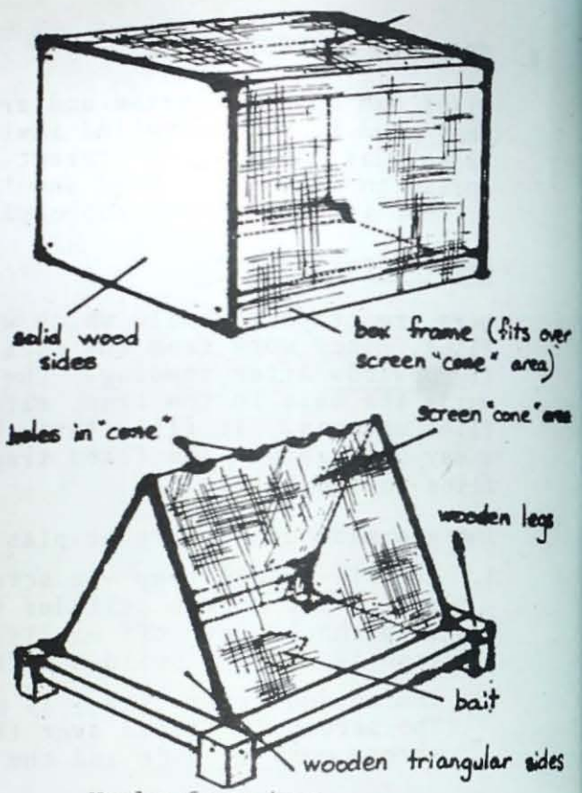
Place in the sun where flies are most likely to visit. Use bait such as fish bones, rotting fruit, chicken or cow manure, table scraps. Replace bait every few days, since old bait won't attract flies. Remove the old bait and put in new bait, so flies won't breed there. The bait has to be inside in the middle of the trap or flies may still be able to escape from the trap.

NOTE: These traps have been tried in a small way so far and they seem to work well. Also, it is better if the whole village uses the traps - this will be more effective in keeping

Adapted from: "Mechanical Traps to Control Flies" by Phillip Crooker in Alafua Agricultural Bulletin, Vol.5 No.2, 1980.



All-screen trap

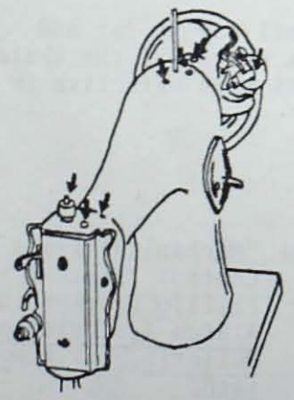


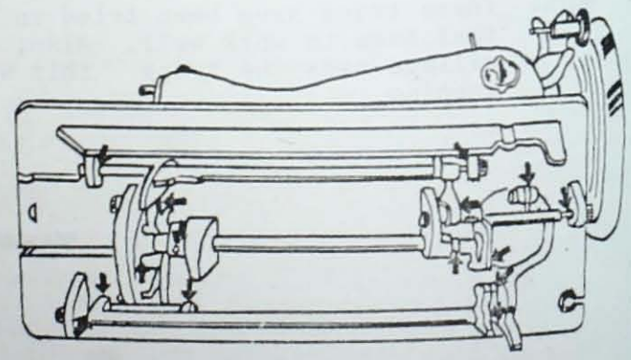
Wooden frame trap

A USEFUL BOOK ON SEWING MACHINES

Basic Sewing Machine Repair,
South Pacific Appropriate Technology Foundation,
Box 6937, Boroko, Papua New Guinea, 1979

This is a good book dealing with the many different things that can go wrong with your machine and how to fix it. It also tells you how to look after your machine properly. It has simple steps to follow and clear pictures to guide you. Available from the address above.





FOOD

FOOD

Simple Techniques of Food Preservation

Fruit and vegetables as well as meat and fish, can be preserved so they will keep longer and can be eaten later. Many fruits and vegetables go to waste when they are in season because not all can be eaten at that time. Food preservation means processing the food or making changes to it so it will not go bad so quickly. The food can be stored and eaten when they are no longer in season.

Mandarins in season. Not all can be eaten at once.

Food preservation can include cooking first and then storing - for example making jams and syrups out of fruit. Sugar and sometimes lemon are added, the fruit is cooked and stored in clean jars and containers. The fruit preserved in this way can be stored in a refrigerator or in a cool dry place.

Crops which do not grow all the year around can be eaten when they are not available. Large catches of fish need not go to waste but can be smoked and eaten later. This is very good in helping to maintain a good diet, so that people eat the foods that they need not just at one time but all the year around.

Drought or flooding can destroy food gardens. Stored food can help at times like this. What follows are a few of the simple ways in which food can be processed and preserved for use later. There are many traditional ways of preserving food. *(More on food preservation will appear in a later manual on nutrition and food production.)*

Preserved food can add variety to the diet. Some foods can be made to replace buying the same food in the store - for example peanut butter, which can be made from grinding cooked peanuts and adding oil or butter. This is a good source of protein. Coconut oil can also be made from coconuts and used for cooking, making soap or even for lighting lamps.

Ways of preserving food

Drying food:

One of the simplest ways of preserving food, used by people all over the world. Food can be dried using the heat from the sun.

Salting and Drying:

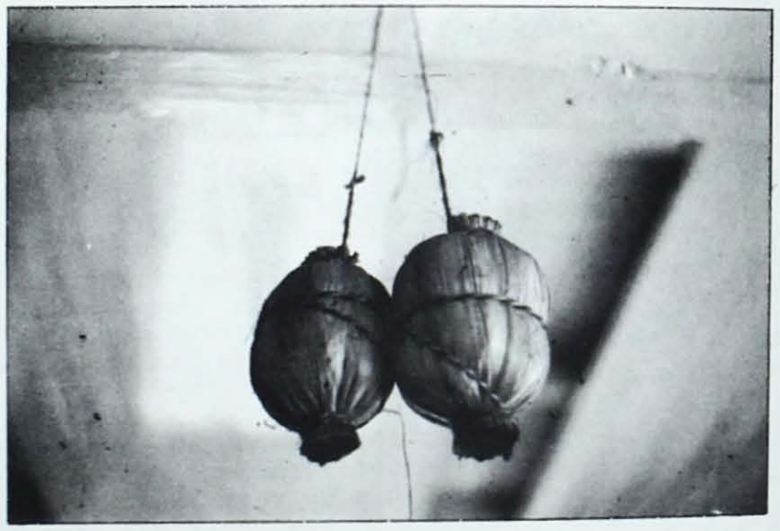
Salt adds to the preservation. The food is then dried in the sun.

Smoking:

Smoking cooks food and also preserves it. Smoke can be used to dry fish and also 'cure' it or make it last for some time if it is stored correctly. Fish can also be salted to help preserve it.

Air Drying:

Many vegetables can be dried if they are left hanging in the air where they will not get wet. The vegetables can be covered with bags or cloth to keep away dust and insects.



A traditional way of preserving bananas in the Cook Islands. The bananas are dried in the sun then wrapped in pandanus leaves and hung in the air to dry further.

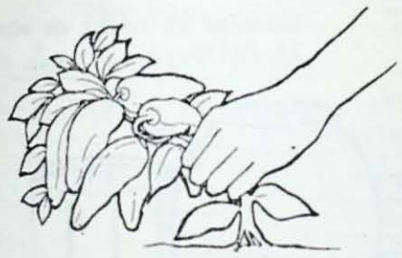
The following are some ways in which different foods can be preserved. Smoking and drying can be improved by building a smoke drier out of drums, and a solar drier can improve methods of drying using the heat from the sun.

A. SIMPLE PRESERVATION TECHNIQUES

1. Air Drying Vegetables

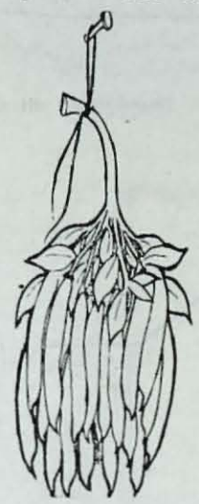
i) Unshelled peanuts can be put in a sack or bag made of coarse material. Hang them from a tree or somewhere where the air will move freely.

ii) Vegetables such as beans and seasoning such as chillies can be dried on the plant then the plant pulled up and left to hang in an airy place.

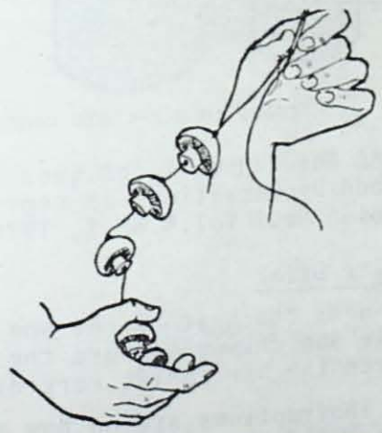


dried on the plant

hung to dry



iii) Mushrooms or beans can be threaded and hung to dry.



2. Sun Drying Vegetables

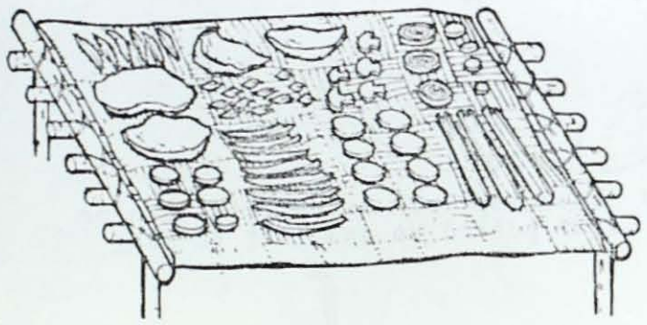
Drying in the sun is simple and needs no special equipment. But the sun needs to be strong and the air needs to be fairly dry.

1. Carefully wash and drain the vegetables.
2. Lay vegetables on trays made from wire mesh or matting or plaited cane or bamboo.

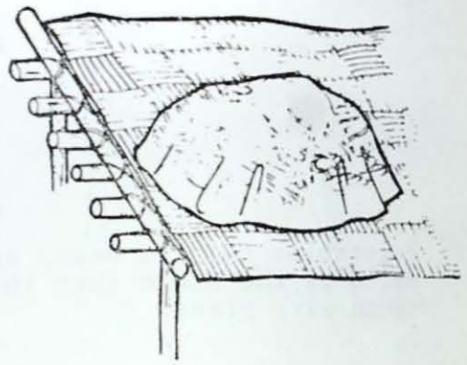
Put a cover of cloth or netting a few inches above the vegetables to keep out insects and dust.

3. Turn the vegetables once a day. Keep trays well off the ground.
4. Put the trays under shelter at night or cover with plastic.
5. When the vegetables are dry and hard, (usually after 3-4 days), pack them close together in dry insect-proof containers or in plastic bags.

To use: The vegetables can be cooked like ordinary vegetables, adding water and salt.



Vegetables on trays



Covered at night or when it rains.

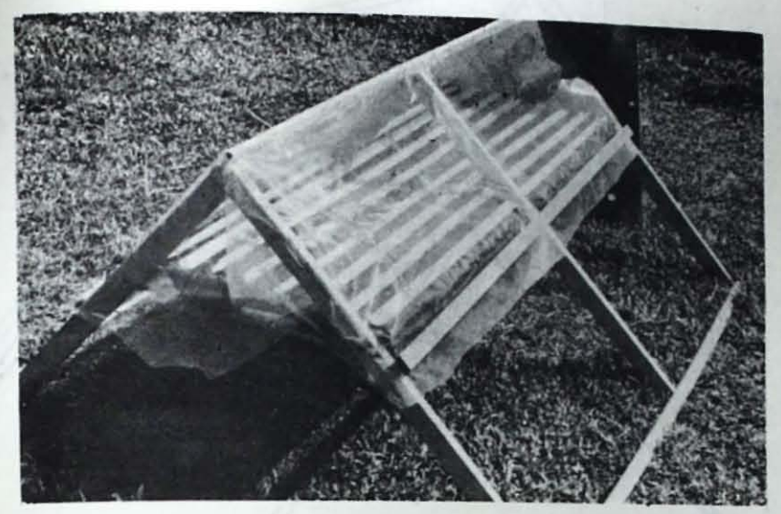
Stored in air-tight containers

From: FAO Rural Home Techniques series, Vol 5, Series 2, Food Preservation, as reprinted in Appropriate Technology Vol.6 No.2 Vol.6 No.3, 1979.

3. Building a Solar Drier

A solar drier uses the heat of the sun to dry food. The drier improves simple sun drying because the way it is built increases the heat and keeps the air inside very dry.

The following instructions are on how to build a large solar drier. If you want to build one a different size, make the frame the size you want and measure the plastic that will cover it. It can be built in the same way as the one described here.



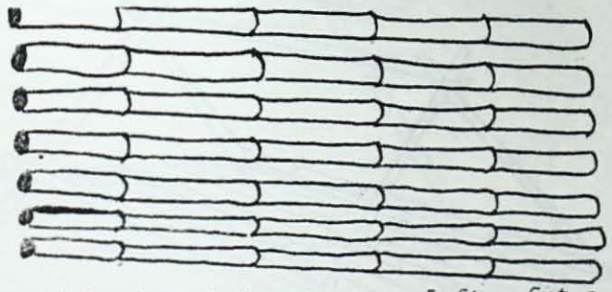
A completed solar drier

Materials needed:

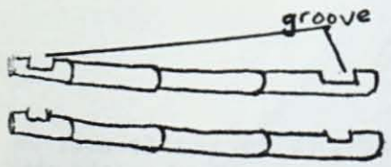
Bamboo
rope
2 metres or 7 feet of 3 metres wide black plastic
6 metres or 20 feet of clear plastic 3 metres wide
some big stones

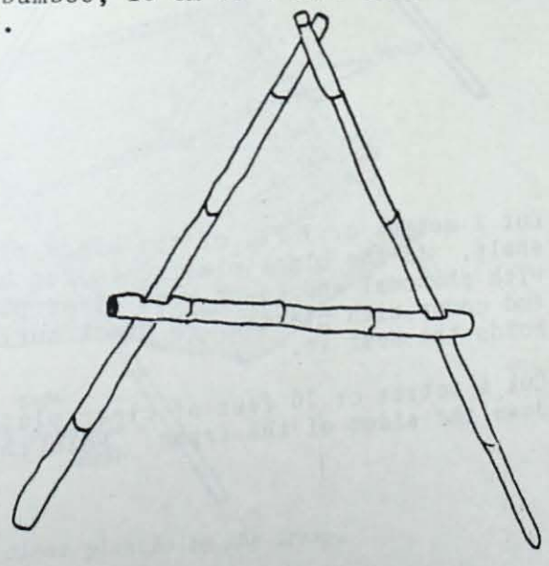
How to make a solar drier:

1. Cut 7 pieces of bamboo, all the same length - 2.5 metres or 8.5 ft.

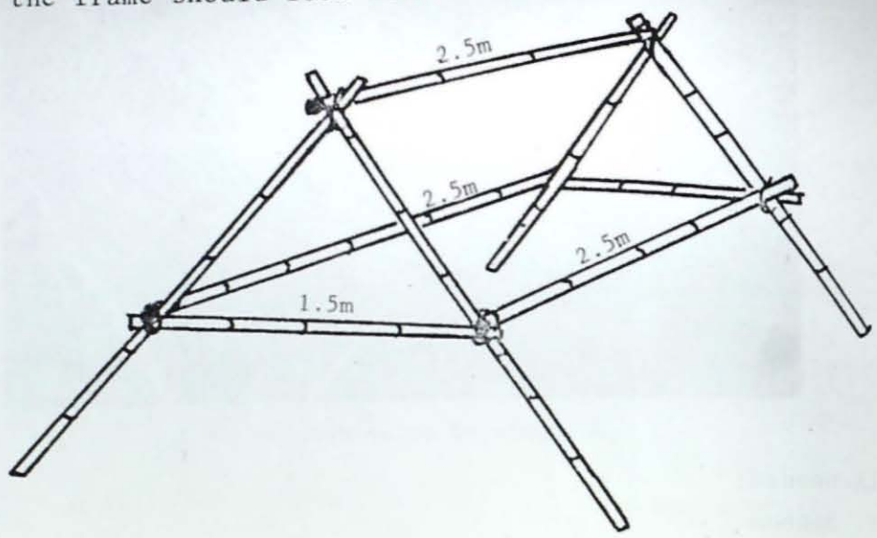


2. Cut 2 pieces of bamboo 1.5 metres or 5 ft. Cut a groove big enough to hold a piece of bamboo, 10 cm or 4 ins. from each end of the two pieces as shown.

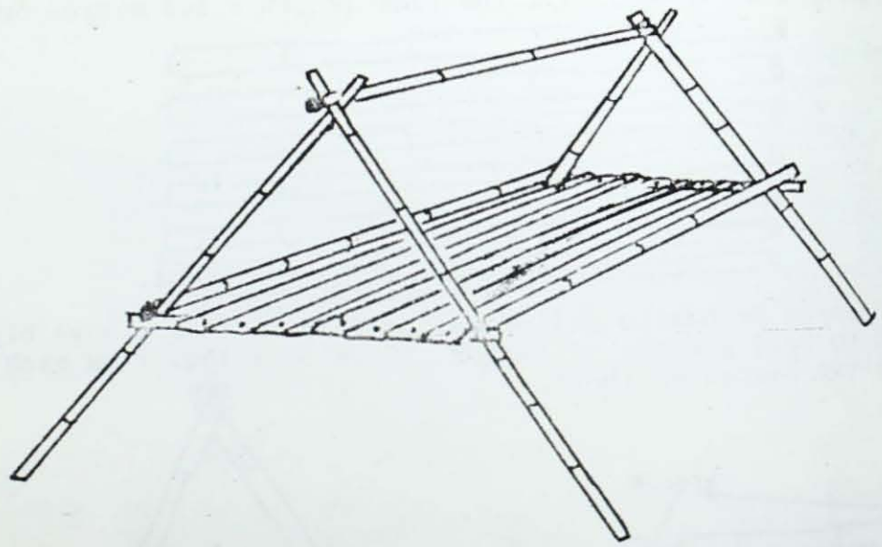




3. Tie all the pieces of bamboo together to make a frame. This is what the frame should look like:



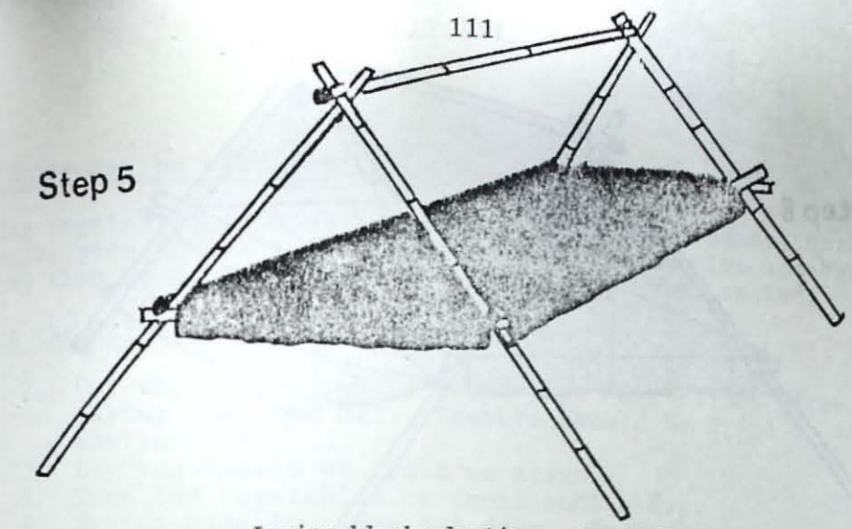
4. Take five pieces of bamboo all 8.5 ft. long. Split them in half to get 10 pieces of split bamboo. Lie them flat to make a shelf as shown. Nail them down at each end, or use vines or split cane to tie them down.



5. Cut 2 metres or 7 ft. of the black plastic and spread it over the shelf. If the black plastic is too hard to get, blacken the shelf with charcoal and cover with clear plastic or use a black cloth and cover with plastic. A black surface absorbs heat better and holds the heat in.

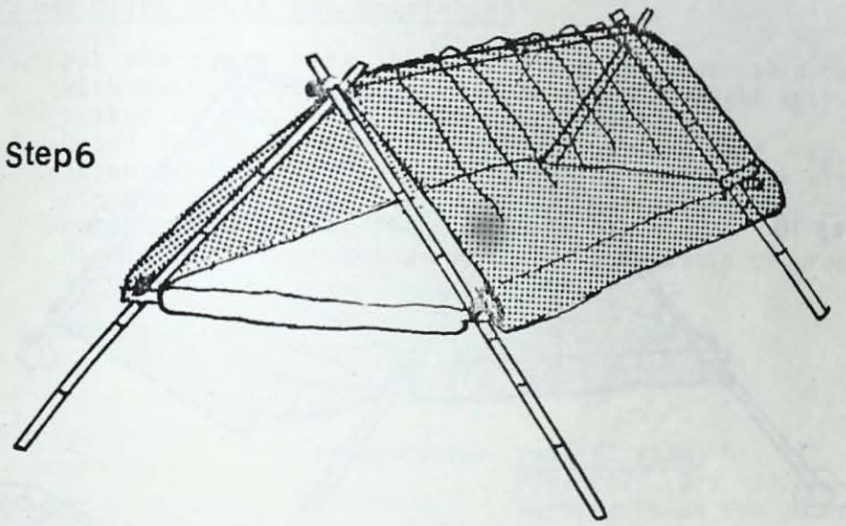
6. Cut 6 metres or 20 feet of clear plastic. Put it over the top and down the sides of the frame. Fold the ends of the plastic.

Step 5



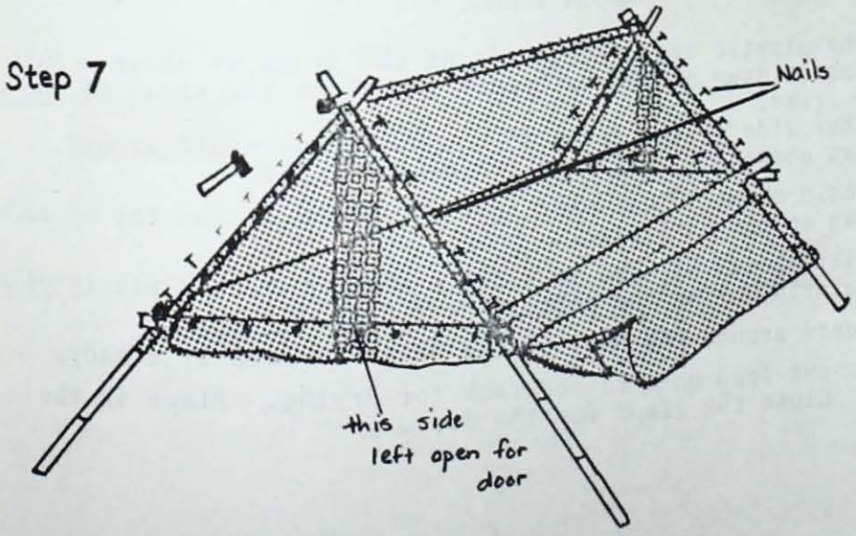
Laying black plastic on the shelf

Step6



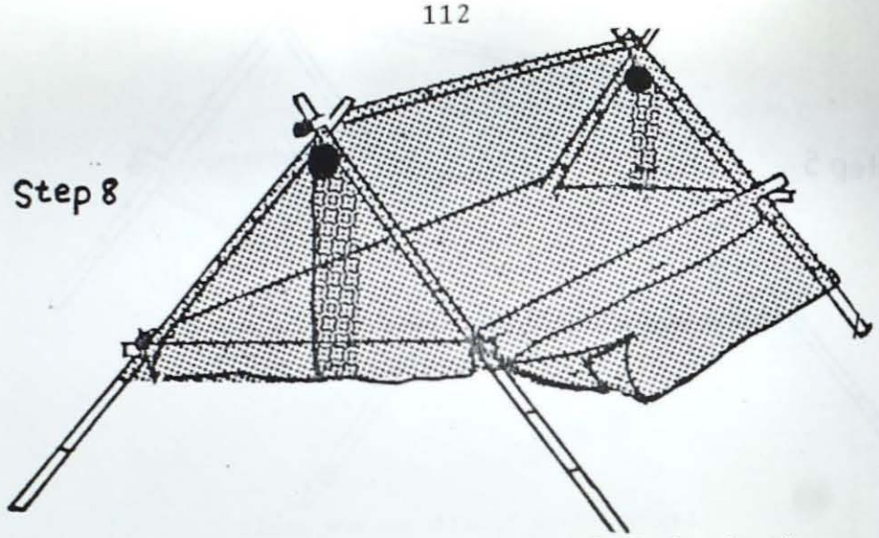
Covering the frame with clear plastic

Step 7



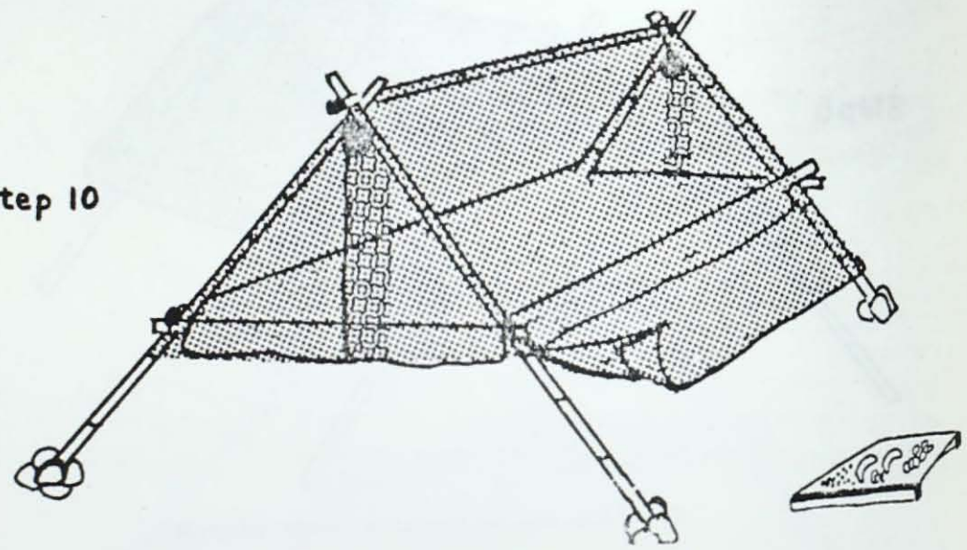
Nailing the clear plastic to the frame.

Step 8



Cutting a hole at each end of the plastic

Step 10



Putting stones around the base to keep it steady.

7. Pull the plastic across the ends of the frame as shown. Nail the plastic down at the both ends and along the shelf of one side of the frame.
   The other side of the frame is not nailed down all around.
   Leave an opening to put food inside the drier.
8. Cut a hole about 10 cm. wide in the plastic at the top of each end, as shown on the next page.
9. The drier should be used in a place where there is plenty of sun, particularly during the hottest part of the day.
10. Put stones around the base of the drier to keep it steady.
11. To use: put food on a raised rack for drying. Place in the drier. Close the flaps for the door.

The drier may be used for:

Drying vegetables such as kumala (kaukau), taro, beans, corn, peanuts, peas, pumpkin, and fruit such as pineapples and bananas. It can also be used to dry fish after it has been salted.

Using the drier:

1. Cut the vegetables or fruit into thin slices after taking the skin off. Peanuts should be dried in their shells.
2. Lay vegetables or fruit on trays.
3. Turn the vegetables or fruit once a day.
4. Drying usually takes 3-4 days. Fruit is ready when it is dry on the outside and soft on the inside.

How to use dried fruit and vegetables:

1. Put the vegetables in water for a few hours then cook with salt. Dried fruit can be eaten straight away or soaked in water for a few hours first.
2. Dried food can be ground into flours and used - eg. bananas, peanuts, kumala (kaukau). Grinding can be done with a stone - put dried food in a cloth or plastic bag on a hard surface and grind.
   Simple grinders such as a mortar and pestle or stones can be used.

Adapted from: Yumi Kirapim, No. 14
OVD/SPATF, Box 6937,
Boroko, Papua New Guinea.

4. How to Smoke Fish

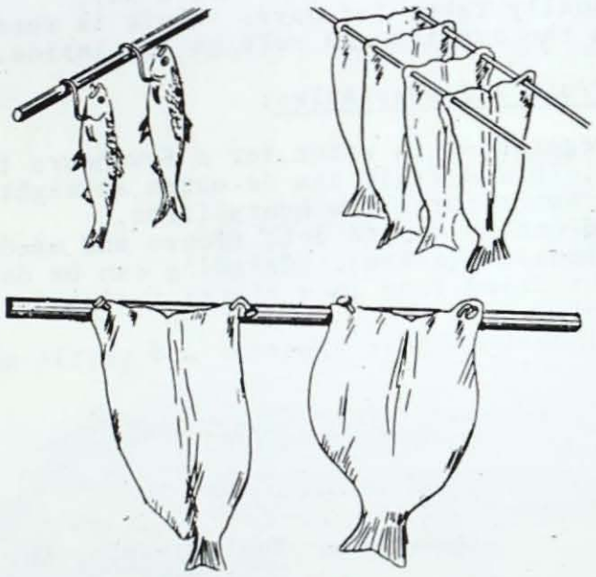
Use:

i) Small whole fish, small split fish, large split fish, pieces
ii) Brine (if needed). Brine is a liquid solution of:
1 part salt to 5-6 parts water.

Smoking Fish

Smoking fish cooks the fish and drys it. This is called smoke-drying. The fish can also be dried afterwards in the sun or air.

1. Wash the fish. Leave the fish in a brine solution if you like. This will add taste to the fish.
2. Hang fish from sticks or wire or place them in a tray in the smoke drum. Don't place the fish too close together.



Ways of hanging fish for drying.

3. Light a small fire in the fire drum. This will dry the surface of the fish. Make the fire bigger to cook the fish. Let the fire stay this way for about 2 hours. Then let the fish continue to dry in the sun. Cover with leaves or netting to keep away flies. The fish should be completely dry in the end and feel like rough wood.
4. Pack the fish in airtight containers to keep dry and keep out insects.

From: Simple Technologies for Rural Women in Bangladesh by Elizabeth O'Kelly, UNICEF, Bangladesh, 1978.

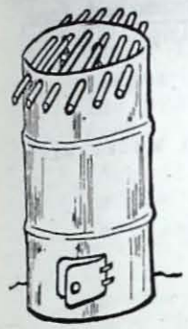
Illustration: Cloudburst, Seattle

To use Smoked Fish:

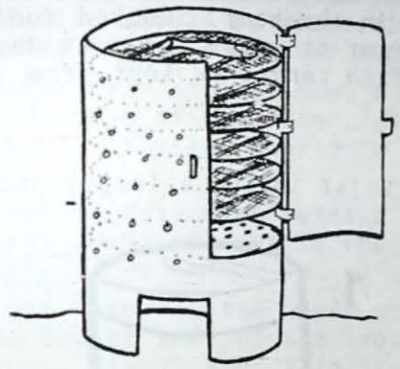
Soak the fish in cold water overnight or for 2 days. Change the water several times. Simmer the fish or pieces of the fish for an hour to soften it. Smoked fish can be cooked and eaten in soups, using coconut etc.

From: Yumi Kirapim, April, 1977.

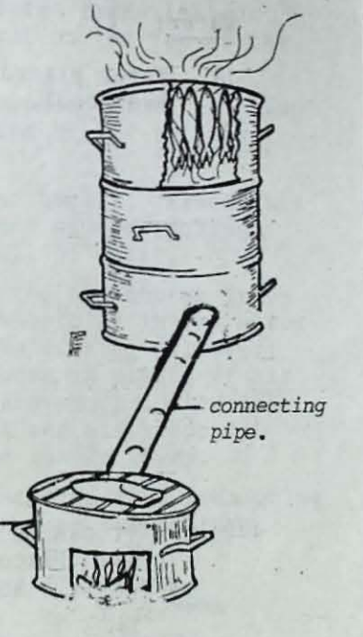
SMOKE DRUMS FOR SMOKING FISH



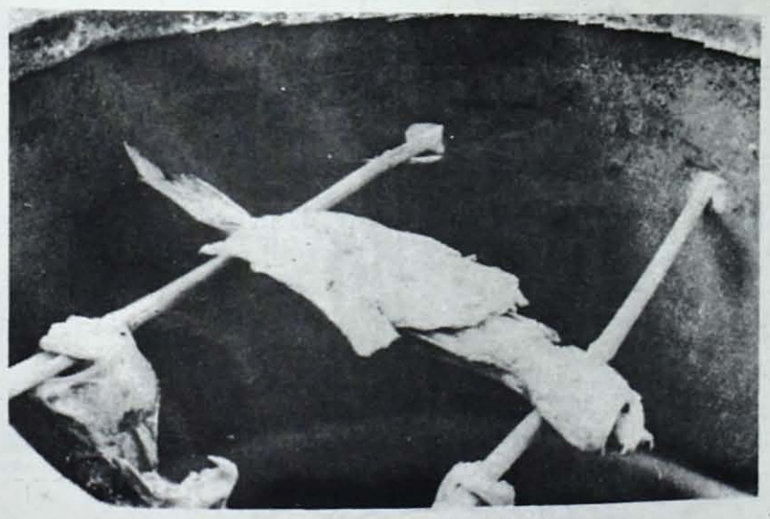
Top shows set of bars for hanging fish.



Oil drum fitted with trays. Bottom is place for firebox.



Adapted from: Simple Technologies for Rural Women in Bangladesh by E. O'Kelly. UNICEF, Bangladesh, 1978.



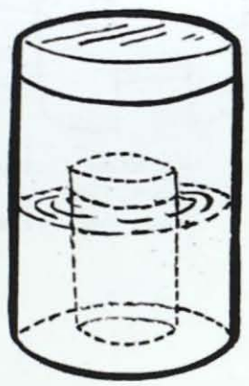
Fish drying in a smoke drum.

5. Keeping Food Cool - Simple coolers

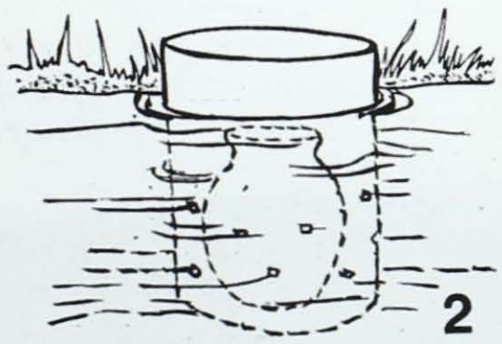
Keeping food cool does not preserve it but it does stop food from spoiling too quickly in the heat. Cooked food kept this way must be eaten the same day or at least the next day. Uncooked food, especially meat and fish cannot be kept from spoiling.

Water:

1) Water placed in a jar inside a larger jar with water will keep cool.



ii) Water can be placed in a jar and put inside a tin with holes in it. Place the tin in a stream or river. The flowing water will keep the water in the jar cool.

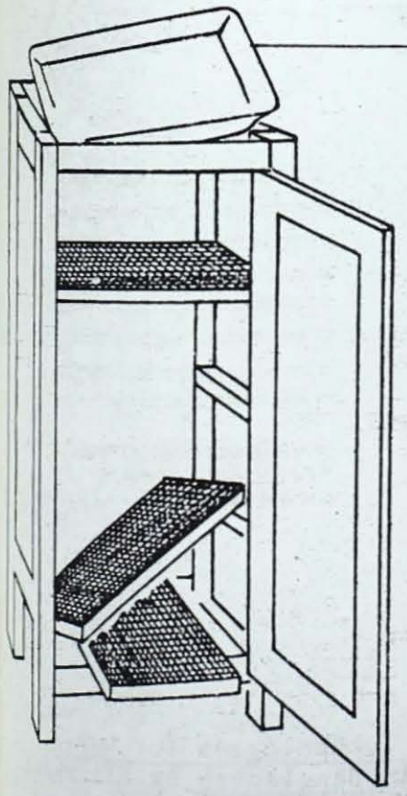


iii) Place water in a jar in a wider dish or pot with water, and cover with leaves.

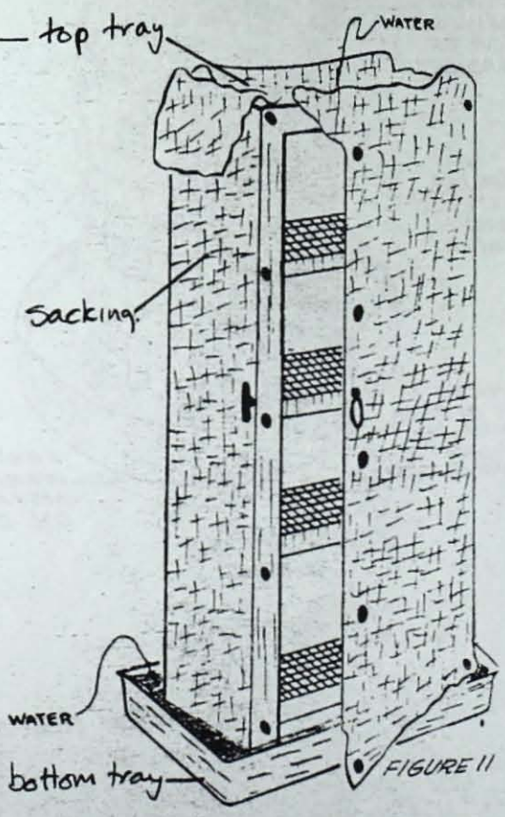
A COOLER TO KEEP FOOD COOL

1. Make a wooden frame similar to the one shown in the picture but not larger than 56 inches high or 12-14 inches wide. The shelves inside should be removable. If it is possible put wire netting on the sides and top.
2. Get a flat metal tray or box about 4 inches deep and a little larger than the base of the frame. Stand the frame inside the tray. Place a similar tray or a bucket on the top of the frame.
3. Cover the frame loosely with hessian or sacking cloth as shown in the picture. Hang it down to the bottom tray - this is very important.
4. On the top, put water in the upper tray or bucket. Place this on top of the cooler and put the loose ends of the sacking into the water. Always keep this tray full of water.
5. Put water in the bottom tray also. Both top and bottom trays should be full of water and the sacking should be in the water. The first time the cooler is used, wet the sacking all over. Stand the cooler in a shady place were there is plenty of air to blow round it. The food inside will stay much cooler than the temperature outside. This happens as the air keeps drying the sacking making the temperature inside lower.

NOTE: This is not a refrigerator. It will not stop food from going bad. It can only keep food cooler than room temperature.



Framework of iceless refrigerator.



Framework covered with sacking.

SECOND ICELESS COOLER

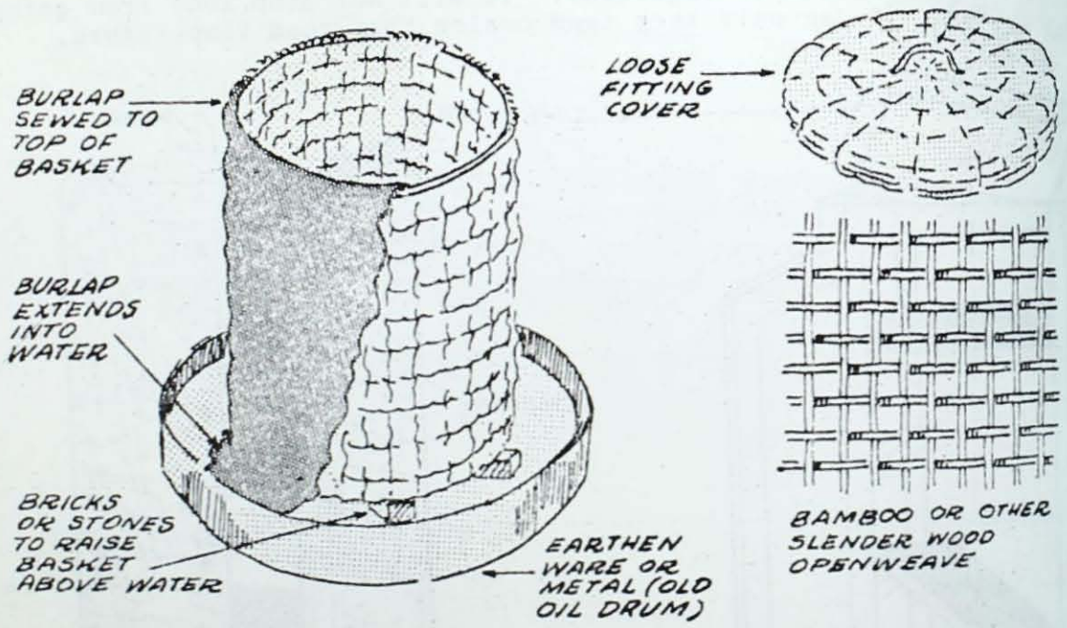
1. Take a large dish which is wide enough for a small basket to go inside.

2. Put two bricks or stones inside the dish for the basket to rest on.

3. Make a lid for the basket. Sew a piece of sacking around the rim of the basket and let it hang loose at the bottom of the basket.

4. Put the food inside the basket and then place this in the dish, standing it on the stones or bricks. Put a little water inside the dish, wet the sacking and let it hand down into the dish. Do not let the basket itself stand in the water. It should be just above it, on the stones.

   If the sacking cloth is in the water at the bottom of the dish, it will stay wet a long time and will keep the food in the basket cool.



Adapted from: Simple Technologies for Rural Women in Bangladesh by Elizabeth O'Kelly, UNICEF, Bangladesh, 1978.

HOUSING

HOUSING

People have made houses for many years out of materials from the bush- timber, bamboo, thatching. Houses that people have built over time are often best suited to the environment or the place where people live. In the Pacific, houses should be built to take into account the heat, winds, rainfall, and also weather problems, such as hurricanes or cyclones which damage houses. In areas where flooding occurs after heavy rain, this also needs to be remembered and houses should be built on high ground or built high above the ground.

New materials such as corrugated iron roofs, bought timber, and concrete bricks are replacing traditional building materials. This is not necessarily a bad thing. People may feel more comfortable in a house which does not leak, and which does not have to be mended so often because of weather damage. Many people want houses which will last longer. New materials cost money however and some of the new houses people build with them are less comfortable than their old houses, though the new ones may last longer. The new houses with tin roofs may be hot, because there is nothing separating the tin roof from the inside of the house. Heat from the sun hits the tin and makes the inside of the house like an oven. Thatch placed over the tin, or plaited bamboo, or light board placed under the tin may help break this transfer of heat. Trees built to shade a house may also make it cooler.

For good housing or shelter we need to consider:

1. Direct heat from the sun. The sun moves from East to West. Planning houses to face away from this path - that is, facing North to South - will protect the house from much of this glare from the sun.

2. Air movement. The movement of air provides coolness and also dryness. With the amount of rain in the Pacific tending towards heavy for most part of the year, the air is very humid (that is, it is full of a lot of moisture or dissolved water droplets). A good passage of air through a house will stop it from being too damp, and protect furniture, clothes etc. from mildew or fungus. It is also healthier for people to live in.

It is important to have air flowing through a house. The air needs to be able to get in, move through the house, and move out again. Windows should be placed where they can take advantage of existing winds and breezes.

Certain materials store heat more than others. The materials chosen for the walls and roof of a house can affect how cool the house will be at night. Materials which store a lot of heat will release this heat at night when the air cools, and will heat the house. For example, a stone floor will store heat if the sun hits it during the day. The floor will release this heat at night, as it slowly cools.

Concrete, stone, brick and steel store a lot of heat.
Traditional materials such as timber, thatch, bamboo, reeds, do not store much heat and are good for protecting the house against heat.

WHAT IS THE BEST HOUSING?

The style of a house, what we make it out of and how we make it will affect how comfortable we are in the house.

1. Housing is also a part of our culture and this is important to remember. We must be comfortable living in our house and it must suit our family needs. If 'family' means grandfather, grandmother and sometimes visiting relations, we need houses with a lot of room.

2. Good housing must also take into account what is outside - the environment or place where the house will be built. Where do winds come from, where will the sun be...?

3. Another factor is cost. We want good houses but not everyone can afford the materials to build a 'good' house. Many people now think that to have a good house, it must only be built of modern materials such as concrete brick, and have a tinned roof and glass windows. All this costs money. Some of these materials are less suited for our climate and unless we are careful and plan our house, it could turn out to be hot and uncomfortable a lot of the time.

Valuing our own Housing

Many people think that only a concrete house is good and spend a lot of money on one because this will make them appear well off in the village. Other people try to follow this example also. But a concrete house does not mean that it is the best housing if it does not cover the points listed above. There are ways in which we can improve our traditional housing while still using local materials, to make a house that will suit us and not cost too much. We must also value our traditional housing - a lot of skill and planning went into building the houses and planning the village and we can still use these skills even in buildings using modern materials.

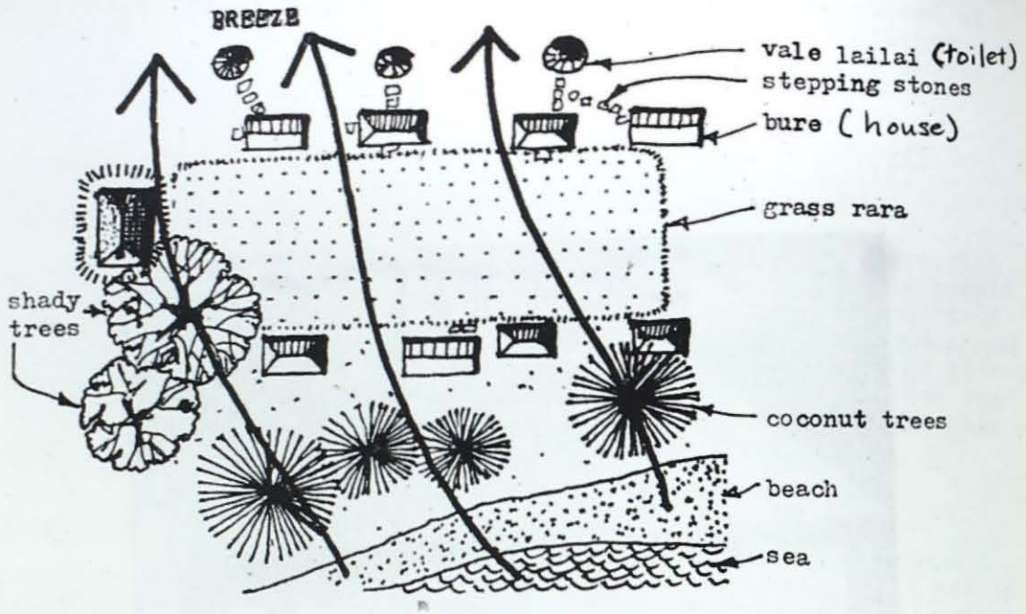
Navala, a traditional Fijian village, with spaced layout, toilets built at the edge of the village. Houses are built entirely of thatch and bamboo, on a raised platform of stones. Note the space between houses.

A traditionally built Fijian bure - thatch roof, woven bamboo walls, raised stone base. The door is of timber.

A Comparison of a Traditional Fijian Bure and a Housing Estate House

1. The place or space in which a house is built will affect the house.

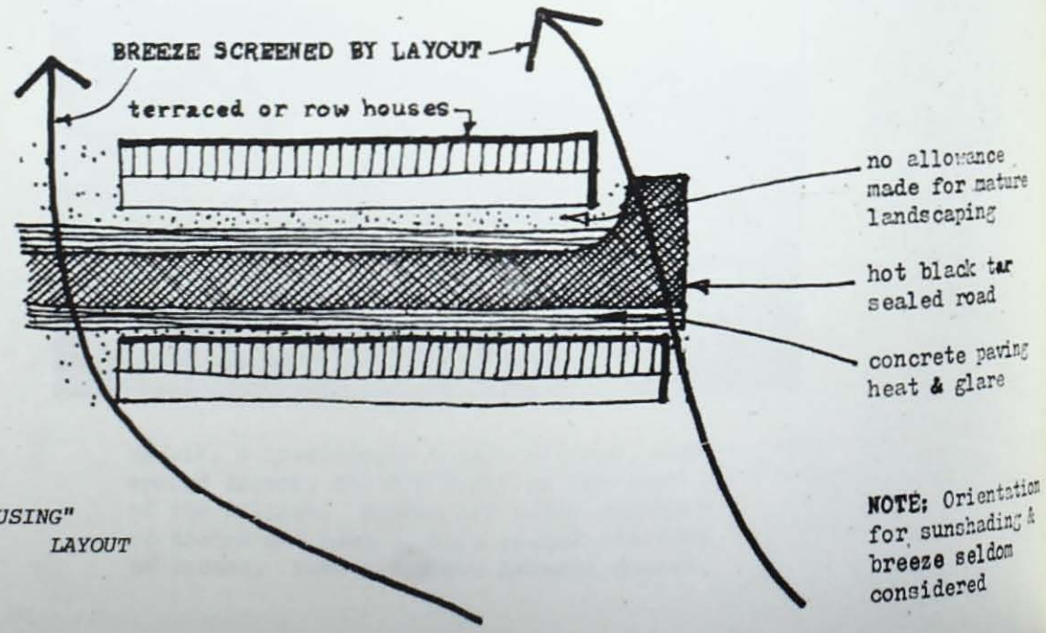
The bure in a traditional village is placed like this:



TRADITIONAL FIJIAN VILLAGE LAYOUT.

There is an open space (grass rara) to let the breeze in.
There are some trees for shade.
Small bushes are cleared to keep away pests.
The grass square is cool and does not attract heat.
The toilets are placed downwind of the village.
There are stones for walking between houses when it is muddy.

The Estate House is placed like this:



"ESTATE HOUSING" LAYOUT

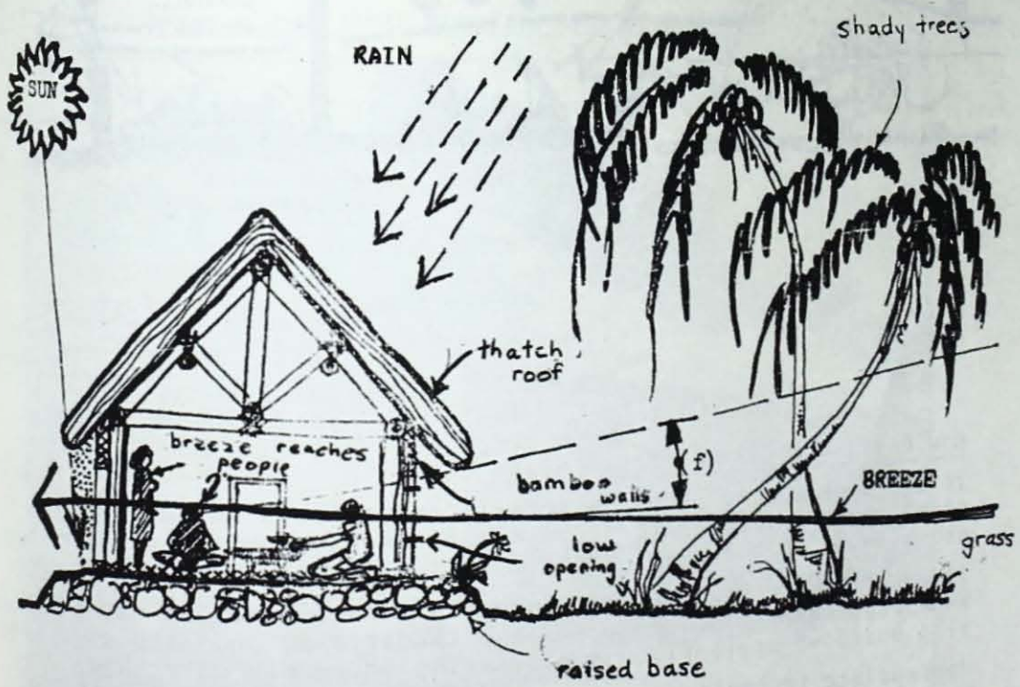
NOTE: Orientation for sunshading & breeze seldom considered

The houses are in a row and block each other from the breeze.
They often face the sun at some time of the day and absorb heat.
There are no trees for shade.
There is a concrete or tar sealed road in the middle which reflects the glare and is hot.
There is concrete around the houses which is also hot.

1. Differences in how a traditional bure and Estate House are built and in the materials they are made of:

BURE:

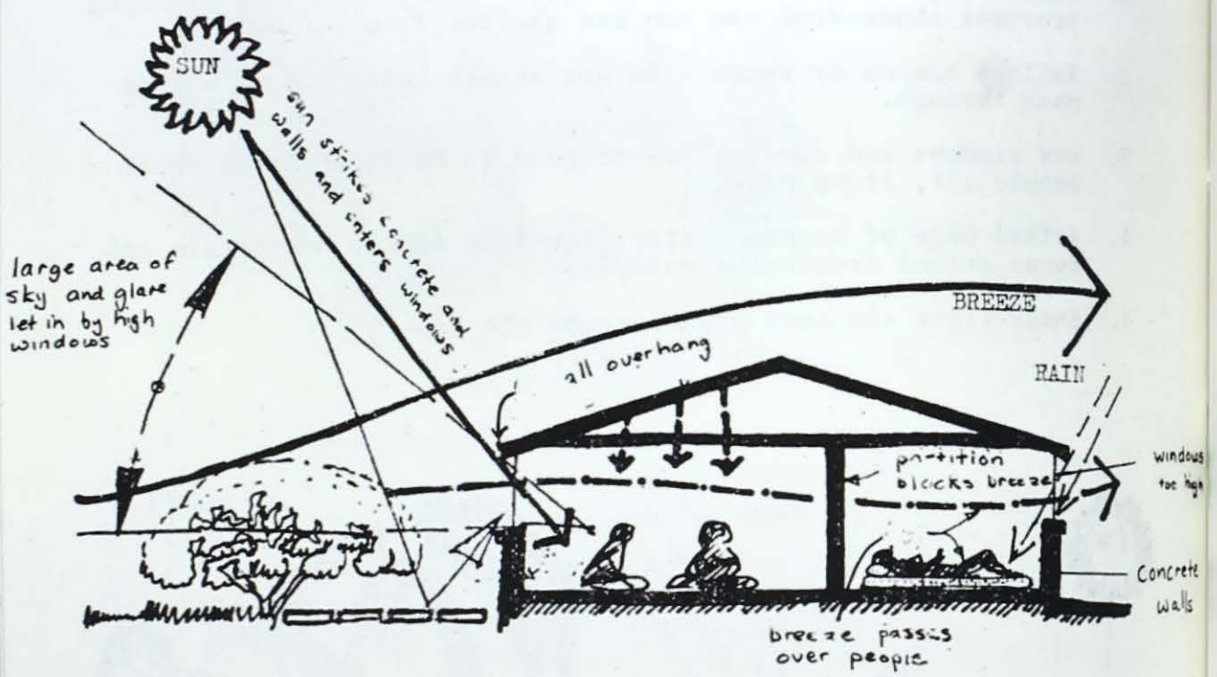
1. Thatch roof - does not absorb heat. Steep slope and overhang provides shade from the sun and shelter from the rain.
2. Walls - bamboo or reeds - do not absorb heat; allows air to pass through.
3. Low windows and doors - breeze goes in to floor level where people sit, sleep etc.
4. Raised base of stones - stops flooding during heavy rain and keeps ground from being muddy.
5. Shady trees and cool grass around the house.



TRADITIONAL FIJIAN BURE

CONCRETE ESTATE HOUSE:

1. Tin roof and painted dark colour (usually) absorb the sun to the inside. Small overhang, so sun enters the house, rain enters windows.
2. Concrete walls unprotected by roof. Absorb heat.
3. Windows high up. Breeze does not reach people.
4. Partitions for rooms inside block movement of breeze throughout the house.
5. High windows let in a lot of glare from bright sky outside.



ESTATE HOUSE

Adapted from: Climate Comfort and Shelter for South Pacific Island People: "The Thermal Environment" by Tony Sansom, F.I.T.

How certain materials store heat

It is important to choose materials for a house which will suit the climate and environment. Some materials as shown above store heat, and release this heat at night. This will make a house very hot.

If concrete and tin are used to build a house, we can use traditional knowledge about placing houses, and traditional building styles, to also build an appropriate house, using these new materials.

Appropriate technology need not limit us. But we must use these materials in the best way for us and to suit our conditions. We do not have to build a complete new kind of house which will be uncomfortable and not suit o u r climate, o r build a new house which is too expensive.

So not all that is traditional is useless and not all that is new is the best. New materials cost money and many people cannot afford to buy concrete bricks and timber, tin and glass, to build a new house.

Below is a brief description of a house built out of some bush materials (BAMBOO and TIMBER) and some new materials (CEMENT PLASTER not concrete bricks). These materials are used to build an improved house which will also be -

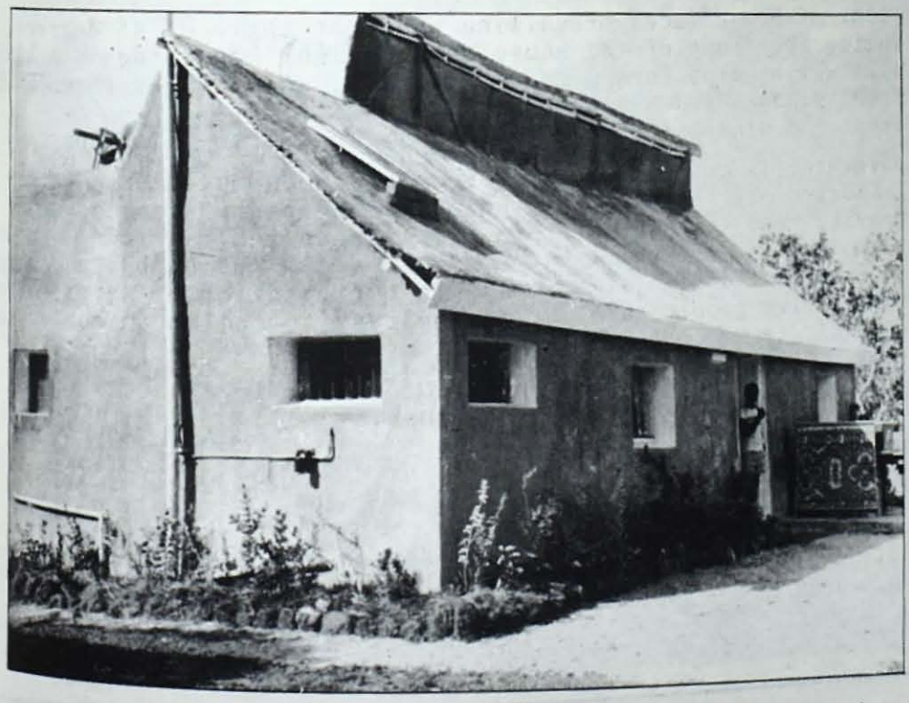
CHEAPER THAN A CONCRETE BRICK HOUSE
CAN BE MADE BY YOURSELF OR YOUR FAMILY
USES BUSH MATERIALS AND TRADITIONAL SKILLS

The house also has a WATER TANK for storing water. It is also possible to build the house with a SOLAR PANEL (this will cost a bit of money) which generate electricity and heat water. The house has space between the walls to absorb heat and allow air to cool the house.

This is an example of how we can use knowledge and skills which we already have along with new ideas and techniques, to build something for ourselves. This is using our own resources plus some new materials to build a house which -

1. does not cost too much
2. uses our own labour
3. is not too difficult to build
4. uses our own resources eg. bush materials
5. can be built by people working together.

HOUSE MADE OF LOCAL MATERIALS AND NEW MATERIALS



Picture of house made of bamboo and timber plastered with cement. On roof (front) is solar panel for generating electricity. On the other side is a water tank.

A HOUSE FOR EVERY FAMILY

Designed by: Dr. Pauulu Kamarakafego
Office of Village Development, Box 6937,
Boroko, Papua New Guinea.

"Anyone if properly supervised, can build a house."

Description:

It is a low cost house.
The use of imported materials is kept as low as possible.
It can be built by self help - people working together for themselves.

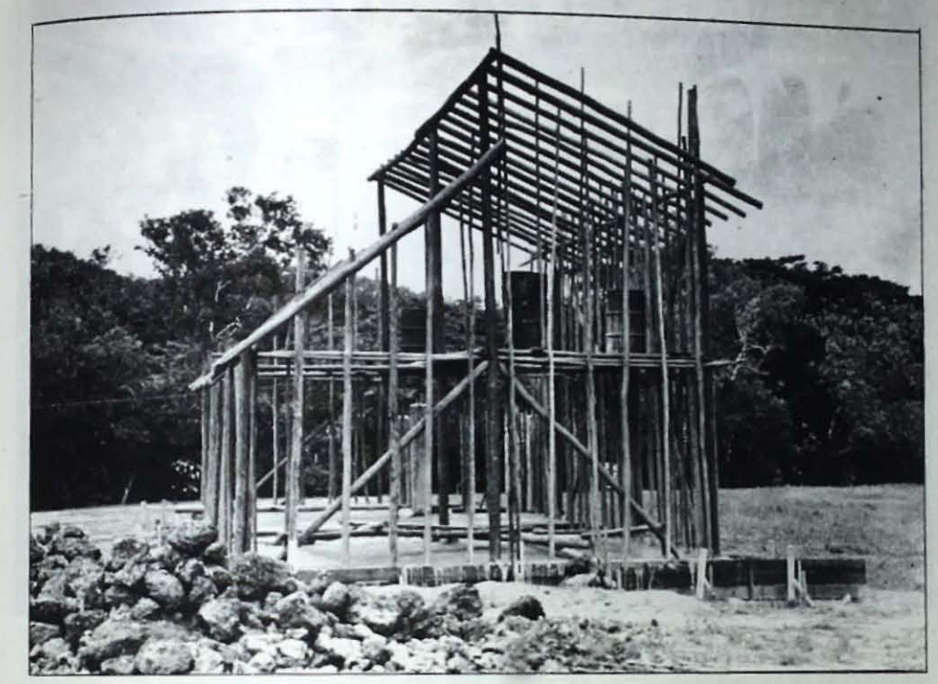
Construction:

Made out of timber, bamboo plastered with cement.
Ceiling of woven mats.
Concrete floor.
Imported materials: cement, toilet basin, shower head, taps.

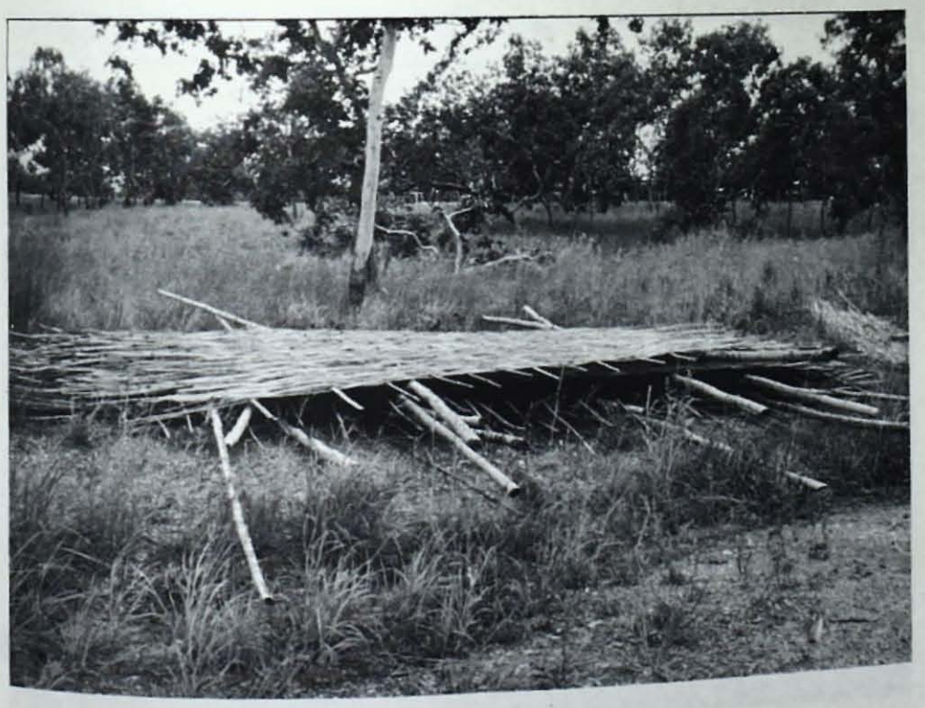
1. Frame of house: woven bamboo. Timber supports - teak, mangrove, any hard wood. Treated for preservation with lime and divai (a root or vine used for poisoning fish).
2. Outer and inner walls: there are two walls, each 1" thick with a 12" space in between. Heat hits the outer wall and it absorbed in the space, and does not hit the inner wall. The inside of the house is always cool.
3. Roof: bamboo plastered with cement.
4. Front of house faces prevailing winds at angle of 45 degrees. Facing the front of the house on the right hand side is a blank wall which helps form a draught of air, which flows through the front windows and out the back windows.
   Front - 3 windows; Back - 3 windows; Upstairs - 3 windows.
5. Rainwater is collected and stored in a household tank. Water is collected off the back roof which is the higher roof. Use of gravity feed to take water to the kitchen and bathroom. Water is collected from the front roof as well. The bamboo and cement roof is coated with lime to aid in purification of water. Tiny fish called guppies are put in the tank to eat mosquito larvae and insects
6. Sanitation: wastes are disposed of in septic tank.
   Water sealed toilet inside the house.

For further details of construction, see manual A HOUSE FOR EVERY FAMILY. Available from Office of Village Development, Box 6937, Boroko, Papua New Guinea.

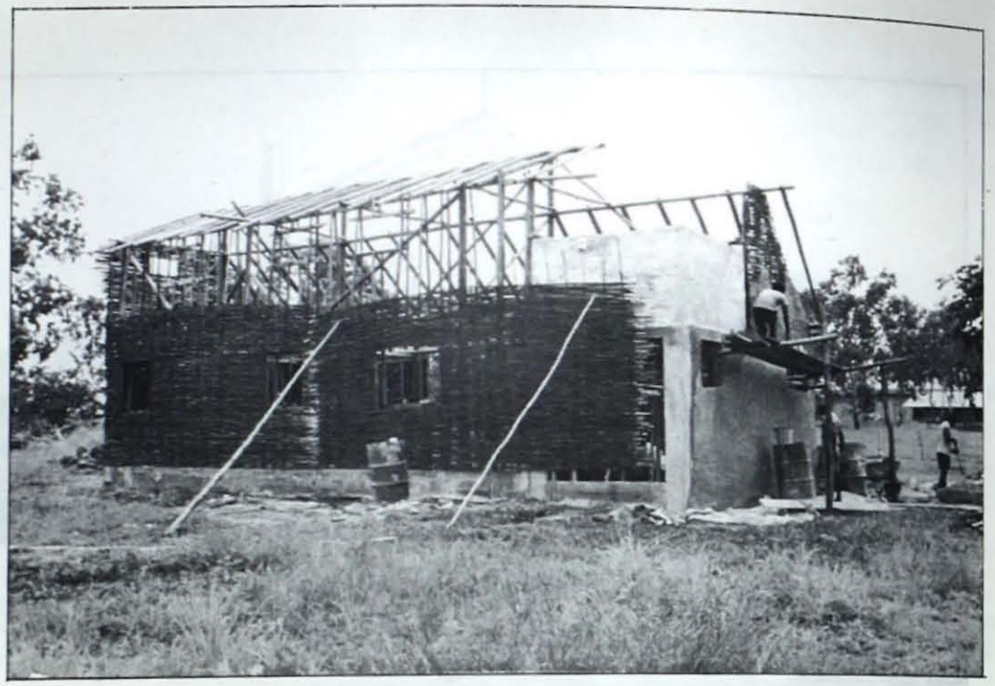
CONSTRUCTION OF BAMBOO AND CEMENT HOUSE



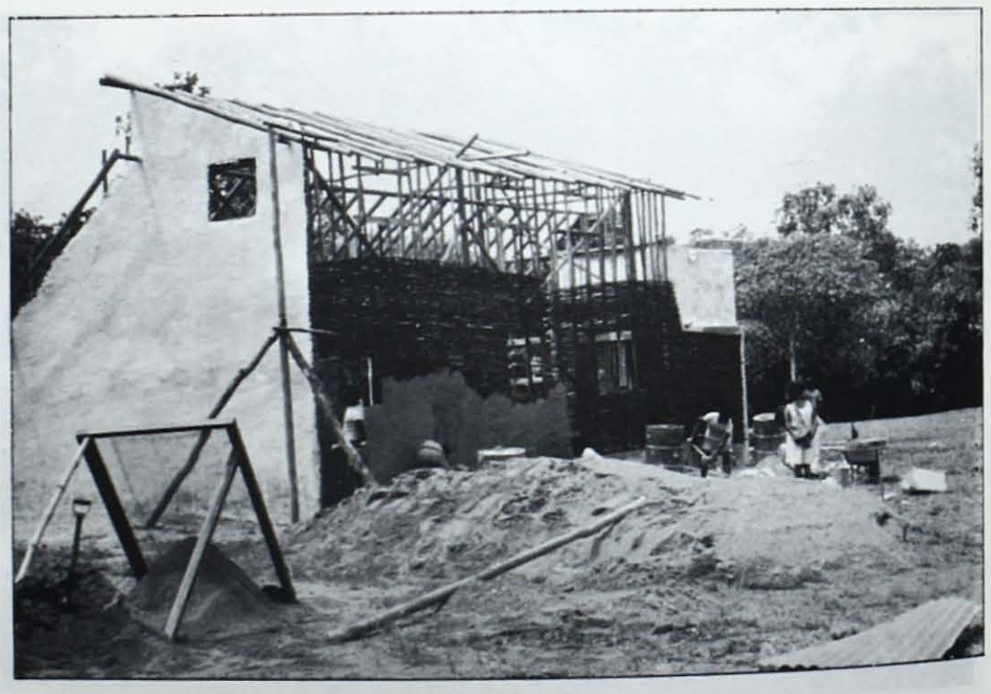
Treated bush timber frame and concrete floor.



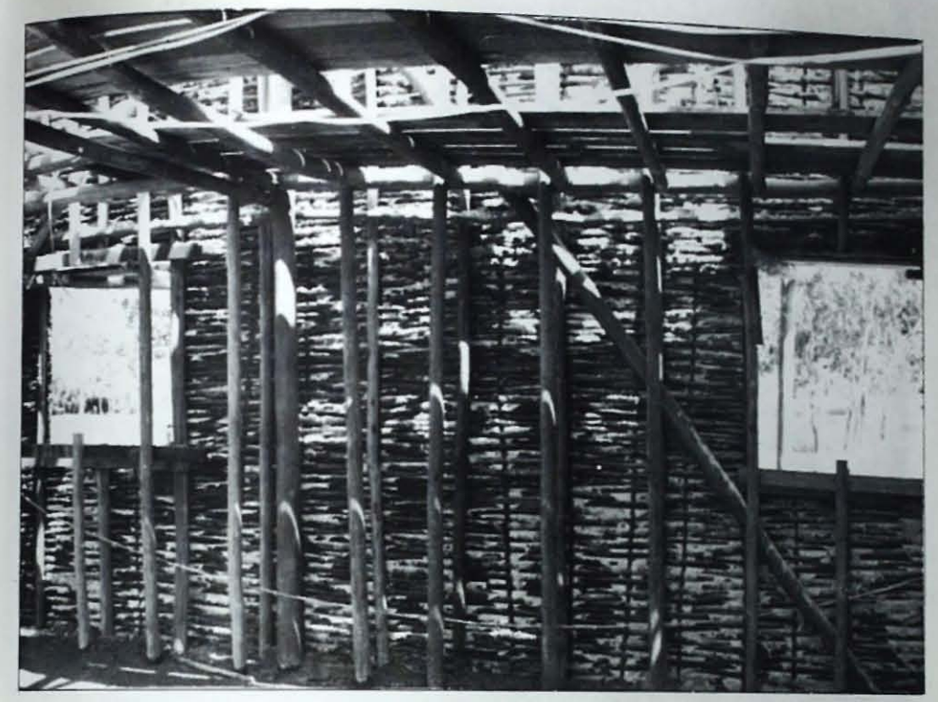
Plaited bamboo sheets for walls and roof.



Plaited bamboo walls in place.

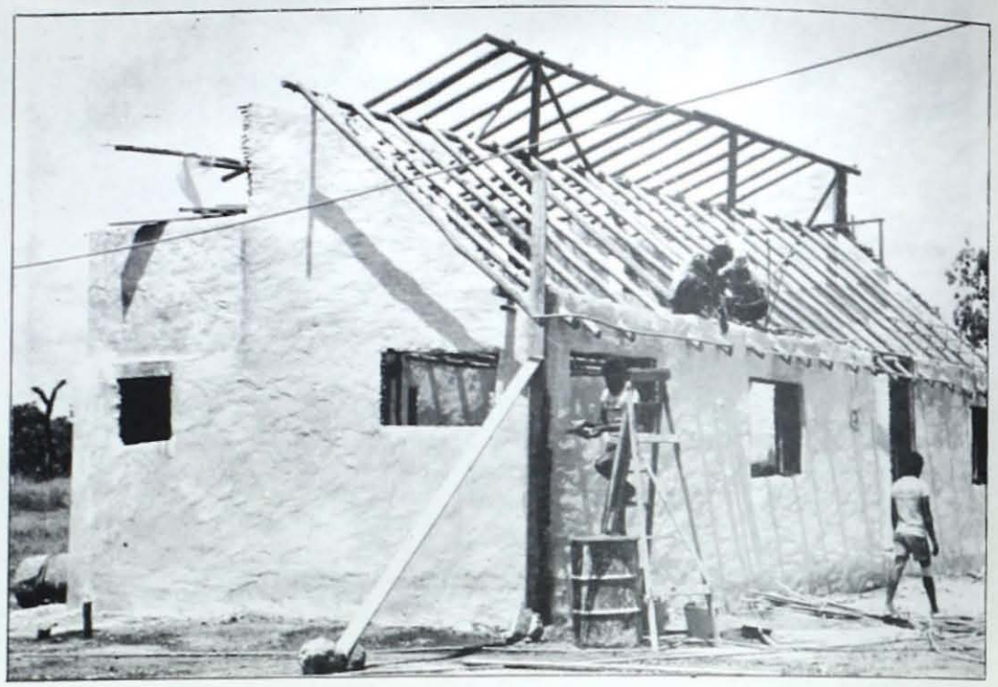


Plastering bamboo walls with cement.

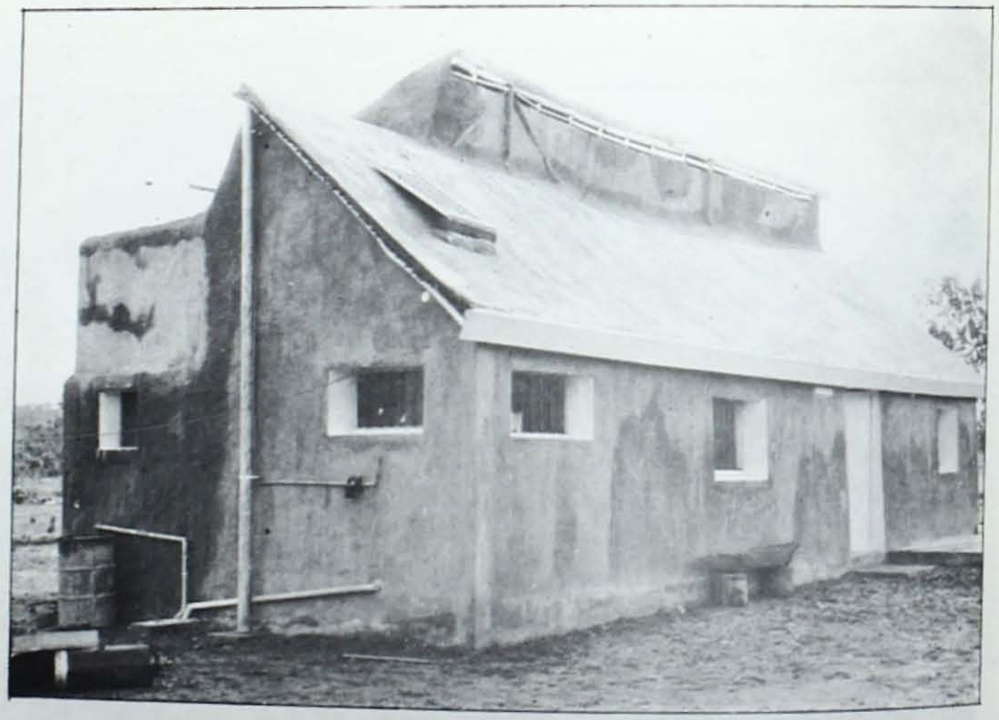


Inside view of plastered wall. Posts for inner wall are in place also.

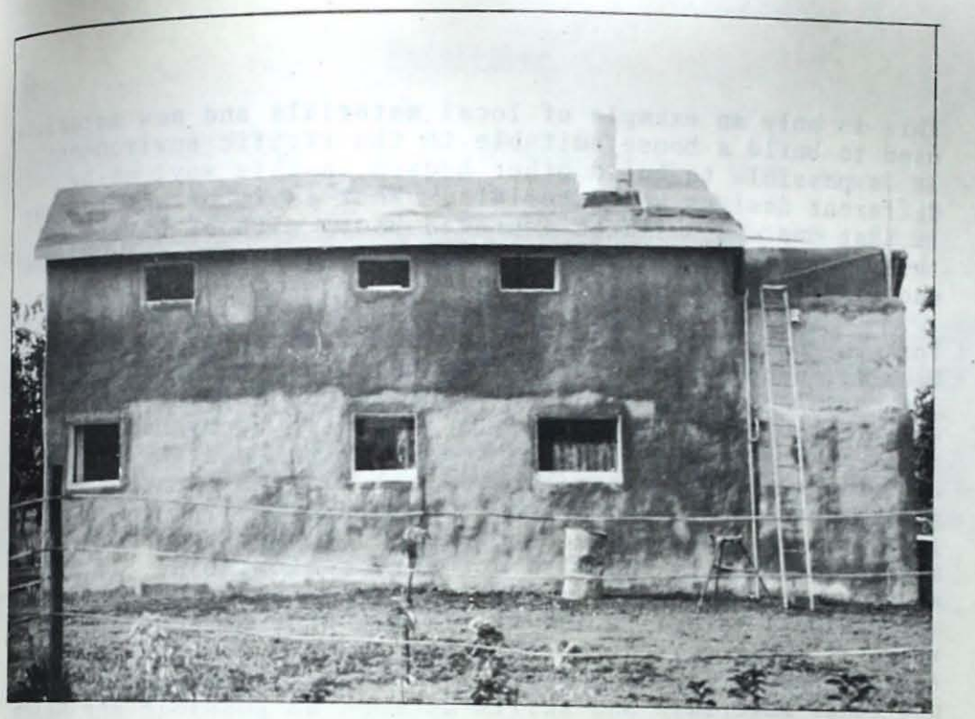
Wall of house being plastered.



Walls completed.



Roof added.



Back view of house showing 6 windows. At right, top, near ladder, is bamboo and cement water tank. Hot water tank is on the roof.

Front view of house. Solar panel is on the roof, at left.

This is only an example of local materials and new materials, used to build a house suitable to the Pacific environment. It is possible to build other houses in this way, using different designs and materials. What is important to know is that one can build an improved house without buying all the materials in a store, and without having to rely on someone else to build it.

For many people, the need for better housing is very urgent. Usually, people are left to find their own housing and even low cost housing schemes, as illustrated, may not always be comfortable or suited to people's needs. Everyone has the right to a good house, which does not leak and which provides adequate shelter for him/her, in all kinds of weather. Most people when seeking to improve their housing, often go to great lengths to build a concrete and tinned roof house which may be very costly and also not very comfortable. If people must change their housing, and it is not always necessary, use of local materials and skills may provide a better house which is still suited to their environment and way of life. What is needed in the Pacific is the design of houses which use local materials and skills as much as possible and which people can afford.

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